

A DICTIONARY OF
ASSYRIAN CHEMISTRY
AND GEOLOGY

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A DICTIONARY OF ASSYRIAN CHEMISTRY AND GEOLOGY

BY

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PREFACE

IT is with no little trepidation that I put forth this Dictionary. Properly to investigate the secrets of Assyrian chemical discoveries, apart from knowing the language and its cousins and the cuneiform texts, the seeker ought to have a knowledge of chemistry (including glass-making), medicine, geology, and botany, as well as to be conversant with the history and methods of the Alchemists of a later date. If I had not been helped by many friends who were specialists in these latter branches, such a venture as this would have been impossible.

Not unnaturally in pursuing clues towards the solution of various Assyrian problems it has been more satisfactory to refer to books and authorities no longer modern, which were far more helpful for the purpose than those which include the advances made during the nineteenth century, particularly in technical science. These later discoveries, which cover vast territories unknown to the ancient world from electricity to aniline dyes, would merely have confused the issue, and this will explain the old quotations often made herein. Yet, although we have to feel our way cautiously in penetrating the arcana of ancient science (which, indeed, were often made purposely cryptic), and conservatively to restrain too eager an optimism about the old men of learning, it can definitely be said that research into the history of their discoveries shows astonishing and unexpected results. They had a sound, practical knowledge of simple chemicals, even to the making of the fuming sulphuric acid in producing colcothar from green vitriol. To go still farther (but in this case we have no definite proof), their apparent introduction of an infinitesimal portion of gold into glass to make '[red co]ral' goes far to suggest that they must have known how to dissolve gold in *aqua regia*. From the numerous results which they had obtained by trying the effect of fire and acids on vegetables and minerals, it is obvious that their inquiring minds, ready to explore any channel of discovery, had an initiative which led them far.

Gladly do I express my thanks to the Trustees and the Director of the British Museum for all the help they have given me in research on the Museum Collections. This, too, the Keeper of the Egyptian and Assyrian Department, Mr. Sidney Smith, has furthered in every way; to his Assistant, Mr. C. J. Gadd, I owe many fruitful discussions over problems which have interested us both. Again, the sister branch of the British Museum, the Natural History Museum, has been ever ready to advise, and I am in debt to Dr. L. J. Spencer, F.R.S., and Mr. W. Campbell Smith for many answers to geological questions. Whenever I have been in doubt about problems in chemistry or glass-making I have had the good fortune to be able to appeal to Sir Herbert

Jackson, F.R.S., Professor Nevil Sidgwick, F.R.S., Dr. Bertram Lambert, Mr. A. C. Pilkington, and Mr. A. B. Searle, and to all of these I tender my gratitude. Professor Sollas, F.R.S., was so good as to make an interesting test on my behalf; for many hints in accuracy of detail I am indebted to Sir John Miles; Major W. C. F. Wilson, D.S.O., who was Administrative Inspector at Mosul when I was excavating at Nineveh, has been so kind as to send me specimens of substances from the bazars, with much information thereon. My thanks are due, also, to Professor Langdon, F.B.A., for his courteous readiness to put his wealth of reference slips at my disposal.

To my College, Merton, I owe my deepest gratitude, not only for its encouragement in the work, but also for the very substantial support it has given me both in excavations in the field, and in the production of this book at home.

R. C. T.

BOARS HILL, OXFORD

September, 1936

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INTRODUCTION

IN any attempt to define the extent of the knowledge of the ancient Babylonians, the utmost elasticity must be conceded in the delimitation of their scientific frontier. That this is no unfair postulate is obvious from the astonishing results shown in the field of ancient Oriental history during the last hundred years; with every advance in our discovery of the capacity and resources of the old peoples we have held up our hands metaphorically in wonder at their unexpected knowledge. A century ago, when hieroglyphs and cuneiform were in their infancy, and winged bulls and Cretan palaces were still below ground, we could see only the dawn breaking in Egyptian and Assyrian archaeology; then, even after the nineteenth century had blazoned forth its archaeological marvels, it was for this twentieth century to reveal an Anatolian dialect in cuneiform bearing close analogies to Greek and Latin, written in a land which knew the Indian gods in the middle of the second millennium; nay, to prove that a thousand years and more before this there had been traffic between the merchants of India and Babylonia. Lastly—that is to say, lately—an alphabetic cuneiform character has come to light in Syria, dating to the thirteenth century, and preserving strange Phoenician myths, again demanding that we shall set no term to mysteries which the soil of the ancient East may hold in store.

So is it particularly in the forgotten labyrinth of old discoveries in natural science. Again, it would ill befit us to set any arbitrary limitation herein, for, even though time has left but little history of the technical processes in which the old guilds of craftsmen excelled, this lack of records does not assail that tyrannic extreme of modernity which would arrogate to recent times the credit of this or that advance along a path which has been slowly built up on the experiments of unknown predecessors. The latest discovery in ancient chemistry, a Babylonian tablet of the seventeenth century B.C. (Gadd and Thompson, *Iraq*, iii, 1st part), gives formulae for making a lead glaze coloured with copper, and is written in just that same cryptographic method which was so beloved of those secretive alchemists of the Middle Ages, a very prototype of possibilities for which we must always be prepared. The fact that a familiarity with certain substances derived from research in natural secrets has not been shown earlier than in the writings of medieval chemists ought not to be allowed to prejudice us against the claims of the more ancient craftsmen, whose credit is apparent in so many extant results of their skill.

There are three very cogent reasons for our ignorance of these actual processes, especially during that long period which bridges the gulf between the Fall of Nineveh in 612 B.C. and the beginnings of medieval

alchemy. First, the actual records are too scanty for us to be able to link up the two periods; secondly, it has always been the outrageous custom of certain learned circles to conceal their knowledge from the lay world in a fog of jargon, a pomposity of mannerisms, due, it is to be hoped, less to personal vanity than to professional protection; thirdly, the knowledge of technical methods was closely guarded by each guild, a natural selfishness aided often by the illiteracy of the artificers who handed down their discoveries from father to son by word of mouth, and consequently their processes, dependent on oral tradition not complemented by the written record, ran the risk of oblivion. We find instructions for this secrecy as far back as the middle of the second millennium in a tablet of the Kassite period, which adds in a colophon to an explanatory text the warning *mudû mudâ likallim la mudû ul immar* 'let him that knoweth show him that knoweth, (but) he that knoweth not, let him not see' (Langdon, *PBS.* x, no. 4, 342), and a similar direction at the end of a seventh-century medical text, *mudû mudâ likallim mudû la mudâ la [ikal]lam* 'let him that knoweth show him that knoweth (but) he that knoweth shall not show to him that knoweth not' (*AM.* 105, 24). Indeed, this jealousy is apparent often in the jejune descriptions made by classical authors, which suggest at least the suspicion that their informants were none too ready to reveal the delicate mystery of their craft to the first inquisitive collector of natural history. Such a palisade of concealment is not confined to antiquity, but has persisted to the present day, particularly among the glass-makers, who preserve not only the tradition of their ancestors' skill, but also their secretiveness.

We can see in our Babylonian tablet of seventeenth-century chemistry every characteristic of the later specialists. The writer makes a point of using the strangest possible cuneiform signs, and at the same time rare or, for that matter, new values to some of those others which are better known to us; he uses Sumerian ideograms in such a way as to show that he intends to pun on the value of the Semitic equivalents, taking for instance the sign for 'eagle' in Sumerian, which has the Semitic value *erû*, which is ingeniously meant here to be read as *erû* 'copper'. For whom he intended this text we cannot say, but the handwriting is so beautiful that it suggests the existence of a professional library.

His is the most difficult expression of this professional jealousy yet known in Mesopotamia. There is a similar but simpler method employed by Assyrian physicians and astrologers, who do not, it is true, attempt any such gross usage of cuneiform signs as this, but they do employ an abbreviated language, different from that of the historical texts, relying greatly on a use of Sumerian values, and certainly warranting the view that they, too, intended to conceal their professional knowledge from the layman. These medical texts are constant in their preference for the Sumerian names of drugs rather than their every-day

Semitic forms, just as the medical specialist to-day will employ Latin equivalents, the chemist his alphabetic formulae, and the botanist his special terms, although, of course, the Sumerian language did not, as far as we know, hold the same claim to represent an intentional cosmopolitan denotation. We find, too, that same queer use of bizarre synonyms of which the medieval scholars were so fond: the Assyrian was as ready to call what was almost certainly opium by the name of 'lion fat' (*lipī nēši*) or 'human fat' (*lipī amelūti*), or castor oil as 'the blood of a black snake' (*dāmi štri šalmi*) (*CT.* xiv, 21, viii, 26, 30: 22, vi, 44: *AH.* 46, 190, 251) as the later alchemists were to give ridiculous synonyms for mercury, cinnabar, cadmia, and such. The word pot-ash, which became latinized into the fantastic *potassium*, is paralleled by the Assyrian *KI. A. AN. ÍD*, literally *kibir ilunāri* 'bank of the river', the word for the sulphur which was found floating on the rivers, the Assyrian word becoming *kibritu*, which was adopted in Arabic as *kebrīt*, 'sulphur, matches'.

It is in curious contrast to all this professional jealousy that the unique series of Assyrian glass-texts of the seventh century, which were made to the order of Ashurbanipal, are written in straightforward simple Assyrian without attempt at cryptography, so that the Assyrian layman might have read them with ease. How an Assyrian king could obtain such professional information in this particular branch, when so many of the other specialist classes of tablets in his library are written in technical formulae, is difficult to explain; it may perhaps be that the medical and astronomical texts are copied from old originals, while the glass recipes were received direct from the dictation of less secretive handicraftsmen who, doubtless illiterate, for some unknown reason handed on their secrets by word of mouth to a scribe who had no axe to grind by hiding their real meaning.

With this plea that we should allow neither the obscurity of the ages nor the professional secrecy of specialists to hamper us in assigning a proper antiquity to the discoveries of the ancient chemists, we can begin to discuss the forgotten Mesopotamian knowledge.

§ 1. *Babylonian Science*

That the Assyrians were a very careful and accurate people can readily be borne out by a study of their text-books in medicine, law, or grammar, and even their very letters. For this reason, when we leave their more scientific work and examine their magical rites, we are entitled equally to say that in whatever they did they had a reasonable purpose at the back of their minds, although it may not be at once apparent. If their outlook on life be duly considered, it will be seen that

even their charms and incantations are not illogical, inasmuch as theirs was a creed which accepted the existence of gods and devils without question, and it was bound to permeate their medical doctrines for a very practical reason. The Guild of Assyrian Medicine must have been well aware of the elementary necessity of winning the confidence of the patient, since the recovery of a sick man depended in no little measure on his trust in his physician's capacity, and in the pacifying of his fears for his own return to health. All the world at that time believed in the efficacy of charms uttered in solemn and resonant ecclesiastical drone, in the mystic employment of wools of different colours which were to be symbolic of phases of peculiarities of sick humanity, in the power of evil-smelling censers to drive away demons, in the potent magic which goes with scapegoats and atonements to transfer the tabu of the sick man to some object, and consequently a proper contemporaneous psychology necessarily demanded an appreciation of all this wizardry in medicine in order that the mental condition of the patient might conduce to his physical improvement, and he thus yield the more easily to the virtue of the drugs prescribed. In other words, all the mystery, the hocus-pocus, and the solemnity are nothing more than a due interpretation of an Assyrian 'bedside manner'. It should, however, be emphasized at once that, although magical texts are numerous and the physician was prepared to make use of their prescriptions at all times, there are in existence hundreds upon hundreds of simple medical recipes, which do not rely on magic in the least; they begin with the diagnosis ('If a man has such and such a sickness'), and follow it at once with a plain scientific treatment without wizardry of any kind.

One of the causes which contributed to the scientific habit of the Semitic Babylonian mind may well have been simply the necessity for reading Sumerian. In order to do this the Semitic Babylonian was compelled to compile extensive lists of signs and vocabularies of Sumerian and Akkadian (Semitic) words, and among these must be particularly noted the clay tablets inscribed with the natural history lists of the animal, vegetable, and mineral kingdoms, from which there are lacking few individual words for animals or substances known to the Assyrians. If we allow about twenty thousand fragments of cuneiform tablets to represent what survives of the Royal Library proper at Nineveh, we can take it that one twelfth of this is devoted to sign-lists and dictionaries.¹ There is nothing like the carelessness of the Egyptian copyists of the Book of the Dead, nor need we look in cuneiform texts for opportunities of brilliant emendation as in the Classics or the Old Testament.

¹ Although it cannot be said that there are no scribal mistakes on the tablets, it may safely be maintained that there are so few that they are negligible, at all events until the decadent periods after the Fall of Babylon (for this see Thureau-

Yet on the other hand, while we can praise the technical capacity of Assyrian scribes to copy texts correctly, attention must be drawn to a peculiarity in the later recensions of literary works, particularly mythological, which has become more marked with the additional coveries in recent years of older editions. Herein we find that the later copies and translations diverge from the early editions so distinctly in the story they tell, that either the scribe must have taken it upon himself to re-edit the story in handing it down, or that the earliest recensions which have come down to us are not those editions from which our later texts were taken. This, however, has nothing to do with the accuracy of the vocabularies in which no alteration was probable.

That inaccuracy was regarded as heinous is clear from the statement made by the scribe at the end of a tablet written in the Kassite period (Langdon, *PBS.* x, no. 4, 329) *ina šertum la uštešir u ina merišum la ušabi* 'he has not drawn (it) up inaccurately nor edited it incorrectly', similar to a passage in a vocabulary composed or copied in the fifth century (*CT.* xii, 3, 29) *ina šertu NU.GIŠ (= la uštešir)-šu u ina merišum la ikalli* 'he has not drawn it up inaccurately nor does he withhold incorrectly'.

But above these lists of natural history three classes of Assyrian documents stand out pre-eminently as showing how great was the capacity of the Assyrian men of science for observation. These are first the astrological texts; secondly, the large number of omens, drawn from every occurrence in daily life; and thirdly the medical receipts.

Assyrian omens derived from astronomy, weather observations, and the like must be kept distinct from the other classes which were written more for private persons. Undoubtedly the obvious purpose of astrology originally was to discern the will of the gods in regard to the future, but in the later Assyrian Empire the watch on the Sun and Moon had a more practical intention than merely to obtain omens. Reports had to be sent to the Palace on the relative positions of these two bodies in opposition or conjunction, so that the length of the lunar month might be foretold some days ahead. Moreover, there is a marked distinction in the very latest periods (down to the first century B.C.) when astrology is entering on a true astronomical phase, and the observations are made with a more scientific feeling. On the other hand the little incidents of daily life from which omens are drawn are more local in their effect, and are naturally limited to the individual concerned, and, as we should expect, the omens continue without change down to the end.

We are not concerned here to go into the details of the Assyrian omen-literature more than to indicate how great a part it played in the education of observation, but, before leaving the subject, it may be well to say that the proportion of omen-texts in the Kouyunjik collection (excluding more than five hundred astrological reports) reaches the large figure of

approximately three-tenths of the whole. If to this we add some six hundred medical texts, we must accept the total of scientific literature—vocabularies, omens, and medical texts proper—as being more than one third of the collection. It represents a patient record spread over many hundreds of years of a careful observation of nature and its scholarly tabulation on thousands of tablets. Wrong-headed and illogical as the omen-literature may have been, through primitive inability to distinguish *post hoc* and *propter hoc*, it played an invaluable part in the training of observers, and shows, even at its worst, no more retrogressive bearing on the normal rate of human progress than the fortune-telling of a later age. Even if an Assyrian glass-maker of the seventh century saw fit to sacrifice to embryos in the hope that the incomplete beings now in the other world would in some way assist his labours in experiment, he thereby acquired that necessary confidence in his essays which a belief in supernatural powers gives man all the world over.

We can now go on to the consideration of their work in those different branches of knowledge of natural history in which the seventh century excelled. We need not trouble ourselves much about subsequent periods: the later Babylonian Empire, after the Fall of Nineveh in 612, endured only for a bare three-quarters of a century, and, as far as we know from its literary remains, it did not make any serious advance on the knowledge of the Assyrians. After the Persian Conquest, when Mesopotamia ceased to have a national feeling, although cuneiform continued feebly in academic circles until well on into the first century B.C., it has as yet provided nothing new, except in the field of astronomy. It is thus to the Library of Ashurbanipal (668–626 B.C.) that we owe most of our knowledge of Assyrian ability at its best.

§ 2. *Assyrian Botany*

The Assyrian Herbal, as we know it from the botanical lists and the medical prescriptions of the Royal Library at Nineveh, contains more than four hundred Sumerian names or expressions for plants, trees, and the like, and nearly twice as many Semitic equivalents for these. In medicine more than a hundred of these were in common or fairly common use as drugs, with perhaps a hundred and fifty more, which were less popular, although, indeed, of these last some may be synonyms of the first hundred. A large proportion of these have been identified with their modern equivalents. These are drawn up in the plant-lists in double columns (the usual method in these syllabaries) which are subdivided into paragraphs or registers by cross-lines, the contents of each register relating either to one particular plant, or to similar plants connected with each other for some reason by the scribe. The arrangement of the order is peculiar, the botanist beginning, for instance, with grass.

reeds, and rushes, and grouping poppy, cucumber, and colocynth together because of their somewhat similar seed-receptacles. The main principle, as in the other bilingual lists, is to give the Assyrian equivalents for Sumerian words which are in all cases easily identifiable as vegetable by the prefixes, either *īṣu* 'wood' or *šammu* 'plant'.¹ The scribe occasionally adds illuminating little comments to these equivalences; e.g. he describes the *ḫUL.LI.LI.GA*, the colocynth, as *tamšil aruni* 'like a ball' (*AH.* 6, l. 78; *CT.* xiv, 18, iii, 10: 21, vii, 12), a simile obvious to any one who has seen these spherical gourds growing on the desert. The *kalû* (which is equated with *nanīku*, the Arab. *nebk*, the *Zizyphus spina Christi*) is said to be 'in the words of the common people "thorn"; it has no juice, its fruit is like a slingstone', the reference being to its dry little spherical fruit (*CT.* xiv, 31, K. 8249; 40, 82-5-22, 576: *JRAS.* 1933, 892: see No. 10 (*d*)). The *kanašû* (the name for *adumatu*, probably the 'red' opium, in the 'Bitter (?) Land') is 'like mandrake (i.e. narcotic), its young female (soft?) shoots holding the juice' (*CT.* xiv, 22, viii-vii, 43), the explanation being that the opium poppy provides a narcotic, milky juice from its leaves, stalks, and especially the capsules, and this is obtained by making slits in the half-ripe capsules (the ripe capsules affording little or no juice) (*VK.* 547). In the same group (l. 45) *GĀN.ZI.ŠAR*, given as an equivalent for *kanašû*, will be seen to be connected with 'hemp' in our next quotation, which I give as it stands in the vocabularies. If *GĀN.ZI.ŠAR* represents a narcotic, we may see in the Sumerian *GĀN.ZI* a group to be referred to *amGĀN.* (= *habbilu* 'robber') and *ZI* (= *napištu* 'soul'), i.e. a drug which takes away the mind.

The following is the Assyrian group for *Cannabis*, hemp, as it is given in a vocabulary, *CT.* xiv, 25, i-ii, 7, ff.:

	Sumerian	Assyrian
	<i>ḫA.ZAL.LĀ</i>	<i>ḫa-zal-lu-u</i>
	<i>ḫā-mi ni-is-sa-ti</i>	<i>ḫa-zal-lu-u</i>
10.	<i>gur-gur-ru</i>	<i>ḫa-zal-lu-u</i>
	<i>GĀN.ZI.GŪN.NU</i>	<i>ḫa-zal-lu-u</i>
	<i>ḫAR.GUD</i>	<i>gur-[gur-ru]</i>
	<i>ḫAR.MU.UM</i>	<i>gur-[gur-ru]</i>
	<i>ḫA.ZAL.LĀ</i>	<i>bur...</i>
15.	<i>ḫA.ZAL.LĀ ut-liš</i>	<i>ḫa...-u(?) sāmu</i>

In *AH.* 100 I took this to be hemp or *Cannabis sativa*, L. *ḫAzallû* can be compared to Syr. 'zal' 'spin', i.e. the plant used in spinning: with *gurgurru* cf. Heb. *gârar* in Hithpa., used of a twisting (?) dust-devil, or

¹ Herein represented by *i* and *ḫ* (just as *abmu* 'stone' is by *a*) respectively for the sake of brevity.

the Assyrian *karara ša mē^{pl}*, the eddies of water (p. 38, n. 2),¹ perhaps the Arab. *karr* 'a cable', especially since *GIŠ.MĀ.GUR.GUR* = *ŠU-rum* (= *gurgurum*) (Strassmaier, *Alph. Verzeichn.*, 1747) suggests a cable, especially for a ship (*GIŠ.MĀ*). "*Šami nissati* 'a drug for sorrow',² coupled with the property of spinning and making a cable, makes 'hemp', *Cannabis*, the Indian *bhang*, *binj*, certain, which is further borne out by the Persian *gargarinj*, *Cannabis sativa*, L. (the *-nj* is a frequent termination). "*GĀN.ZI.GÜN.NU* is one of the most interesting words in cuneiform; we have already seen that "*GĀN.ZI.ŠAR* is "*kanašū*, a narcotic 'like mandragora', presumably opium: *GÜN.NU* is the equivalent of some form of *burrumu*, originally apparently 'to twist, weave' (*Šurpu*, v-vi, 115), as well as 'to be two-coloured'. Consequently the word = "*GĀN.ZI* + "weave", i.e. the weaving narcotic, and there is great philological similarity between this and the Hindustani *gāñjhā* (cannabis), a point which Sir David Prain pointed out to me. We have thus another probable link between Sumer and India.

"*ĤAR.GUD* must be 'the plant of *ĤAR.GUD*' (= *ibaru*, *ballu*) fodder, but whether this represents the hemp oil-cake, a valuable food for cattle, is uncertain (*EB*. 11th ed., xiii, 263). The use of "*azallū* 'hemp' in *MT*. is both internal and external, and, as Herodotus (iv, 74, 75) says, it was used by the Scythians in fumigation.

The botanical lists often include the synonyms for various plants in use in foreign languages: e.g. "*sa-am-tu* = '*Ū. GIR ina Me-luḥ-ḥi* (*CT*. xiv, 21, vi-v, 22, and 46, *Rm*. ii, 203, 8), i.e. "*samtū* (the mod. Eg.-Arab. *sunt*, acacia) = thorn in Meluḥḥi (Egypt)'.

§ 3. *The Animal Kingdom*

Again, the cataloguer was equally careful with animals, birds, fishes, and insects, but in the case of these he was not quite so prone to add the same glosses as the botanist was wont to do. At the same time, in three-column tablets which usually give two Assyrian synonyms for the Sumerian word, he may be explanatory in his third column: *bušu* (or *širšu*) 'bat' = *iššur hurri* 'bird of the cave' (*CT*. xiv, 4, i-ii, 7); and the [*alal*]*lum*, which is the 'many-coloured Roller' of the sixth tablet of Gilgamesh, whose wing Ishtar broke (as he shows by his tumbling flight in the mating season), so that he cries '*kappi, kappi*, my wing, my wing!' (not unlike the startled screech which he gives), has the explanation in the third column *kappa ippuš* 'he makes *kappa*' (*CT*. xiv, 6 r. 1).

¹ Professor Langdon (*RA*. 1933, 109) would make it the plant 'rocket' from Talm. *gargirā*, with which, I fear, I cannot agree.

² Pinches got as far as 'Herb of grief', *PSBA.*, 1909, 64, but did not pursue it farther.

§ 4. *The qualifications of the ancient Assyrians as Chemists and Geologists*

Southern Mesopotamia is singularly jejune in minerals; Assyria and the Upper Euphrates are a little better; but it is only in the mountainous regions that mineral resources can be described as rich. It was this lack of stone, of course, as well as the natural resources of clay, which led them to build almost entirely with brick (and even that was commonly unburnt, because of the expense of fuel). The stone blocks on which they wrote their inscriptions, in the south at least, had to be brought from afar (for a specimen *in situ* at Abu Shahrain, see *Arch.* 1920, pl. v, E).

We cannot, of course, say at what period the working of gold and silver began in Mesopotamia, because these are precious metals and, as such, are the first forms of booty which an invader takes; but the Sumerians had learnt how to treat both most artistically by the time of the burials in the Royal Tombs at Ur (p. 58, and *UE.* 299). It is copper which survives as the earliest metal, although the Sumerians did not use it until some time after they had settled in the country. Bronze comes in about the end of the fourth millennium, and then, curiously enough, it disappears for a short time, copper taking its place. Iron, too, not only meteoric iron, but iron free from nickel, was known as far back as 2700 B.C., although its general use is much later (p. 80).¹

It was, of course, through experimenting with fire, accidentally or intentionally, that prehistoric man learnt so much about the properties of minerals. In the latest periods the Assyrian method of producing fire was by flint and 'steel' (see *surtu*, p. 125), but the properties of pyrites were also known (*apindû*, p. 88), and it is even possible that a 'sulphur match' was used (p. 39). The persistent tests made by Mesopotamian man with fire on various substances had shown him the effects on the alkaline plants, which gave him potash for washing, and making glass: similarly plaster (which goes back at least to Gudea's time, p. 148) and lime (at least to the seventeenth century, p. 150), had come from the burning of various minerals, and, while we have no date for the melting of ores, we can set an approximate period to the mixing of ingredients for bronze.

But besides the discovery of bronze-casting, I am inclined to think that the Sumerians by the middle of the third millennium were using a kind of brass or gun-metal (if my suggestion on p. 77 is correct), compounded of

80.05 per cent. copper
13.34 per cent. tin
0.77 per cent. zinc oxide

which is to be deoxidized with 5.84 per cent. charcoal.

¹ I may add here that Mr. Mallowan has a note on a piece of prehistoric non-meteoric iron which he found in his excavations at Chagar Bazar (in *Iraq*, iii, 27).

This would allow us to suppose that the *tuskû* (spodos, the heavier oxide of zinc, no. 7(f)), and the *lulû* (pompholyx, or lighter oxide adhering to the upper part of the furnace, no. 7(g)) were recognized long before their inclusion in the vocabularies of the seventh century and the medical texts from Ashur, which are earlier in date than these vocabularies. A third form of metal from the furnaces is the *placitis*, *nipša erî* (p. 73), and a fourth, *ipri erî*, 'copper dust'.

The early successes with fire-experiments led man, doubtless, to roast everything he could find, and so to discover at various periods that copper would give black and red oxides for a colour in glass (p. 67), that *kalû*, yellow ochre, would give *kalgugu*, a red-coloured earth (p. 31), that white lead would produce red lead (p. 135), that *AS.GE₄.GE₄*, native arsenic, would afford a garlic smell in making *MUH.AS.GE₄.GE₄*, arsenious acid (p. 54), and finally, that green vitriol would give colcothar and sulphuric acid (Introd., § 9).

At some time in the first half of the first millennium B.C. the Assyrian was using the word *IM.KAL*, *isikku* for 'sublimate' (which was taken over by Syriac writers in the form *assâkâ*, p. 24). He must long have known the method of obtaining *sal ammoniac* from the dung-fires (p. 12), and this would have paved the way to the discovery of mercury (*IM.KAL.GUG* 'sublimate of the red') from cinnabar (p. 29). Indeed, his knowledge of oxide of zinc obtained from the furnaces goes back to an early time (p. 71).

By leaching the soil he obtained salts (p. 6 ff.), and he applied the word for 'washing' to saltpetre (p. 8), zinc (p. 73), silver (p. 62), and copper (p. 70). He had a good knowledge of vegetable acids, of which there were four, called *A.GESTIN.NA*, *tâbâtu*, vinegar, 'water of wine', with a stronger form *A.GESTIN.NA.KALAG.GA*, 'strong vinegar', and the third *BIL.LAL*, *enšu*¹ or *tâbâtu*, a form of vinegar (which occurs side by side with *A.GESTIN.NA* in the same prescription, *AM.* 37, 10, 9). The fourth, *hallu*, is late. Vinegar, he knew as far back as the seventeenth century (p. 71), would produce verdigris from copper, and, if I am right about *ZA.TU*, he was aware of white lead as a product of lead and vinegar, which by roasting would give red lead (p. 135). It would seem that he even went so far as to indicate by this prefix the effervescence of certain minerals on the application of vinegar (p. 140).

Again, parallel to this, the Assyrian geologist must surely have had a test for the hardness of rocks. This, I believe, was indicated by the

¹ In identifying *A.GESTIN.NA* as vinegar in *PRSM.* 1924, 21, (rather than the 'wine mixed with water' *Kû.* 83, *HWB.* 298, *D.* 579, 247) I was wrong in saying that we had as yet identified no proper word for vinegar in Assyrian. Meissner (*Bab.-Ass.* i, 241) already knew *enšu* as the Heb. *hōmeš*. It is written *inši*, *KAR.* 225, 2.

addition of the signs *AŠ* and *AŠ.AŠ* after certain stones (but not arbitrarily) to show two different degrees of hardness (p. 143). This indication of an early scale of hardness is particularly shown in the ratio *^aZA.GÌN*, *^aZA.GÌN.AŠ*, and *^aZA.GÌN.AŠ.AŠ*, where the first, the softest, is *uḫnū* 'lapis lazuli', and the last is *šipru* 'sapphire,' one of the hardest kinds of stone the Assyrians knew. This, of course, is a form of corundum, which the early Babylonians used as emery (*^aAŠ.MUR*, *amulpis*, 'emery') using the term *ⁱpilakki UD+ŠAL+KAB* (= *algamišu*) 'drill of amethyst' (another form of corundum) (No. 30), Hayes Ward (*SC.* 9) assigning the use of the bow-drill and emery to the Kassite period (c. middle of the second millennium).

The magical use of what may have been white coral (no. 23 (*a*)), used as it was in a charm with 'powder' of iron and copper to attract favour, like magnetic iron and iron filings in a love-charm (p. 86), suggests that the Assyrians had learnt the property of certain substances to attract particles after friction. Amber, however, I cannot identify.

Lastly, as has long been known, the later Assyrian had begun to cast silver coins (p. 63).¹

§ 5. *The Materials of ancient Glass*

These are the details of the various materials for ordinary glass-making as given in *TC.* ii, 571:

Silica, in the form of quartz, ignited flints, white sand, and ordinary sand:

Potash, in the form of purified potashes:

Soda, in the form of native carbonate, trona, by the Egyptians, and in the form of artificial carbonate from kelp:

Lime, in the form of calc-spar, marble, chalk, or limestone:

Lead, in the form of red lead, white lead, or litharge.

A decolourizing agent (with the object of oxidizing the iron and carbon) is usually added: this, for lime glass, is manganese dioxide, arsenious oxide, or saltpetre: for flint glass, red lead.

The lustrous glass known as 'crystal' is made of silica, potash, and red lead.

The still more lustrous glass, known as 'strass' (which is the base of artificial gems) is made of silica, boric acid, potash, and red lead (Findlay, *Chemistry in the Service of Man*, 224).

In an admirable article 'Glass before 1500 B.C.' (*AE.* 1934, 7), H. C. Beck explains the difference between glass, glaze, and faience. Ordinary

¹ For *pitka* as a possible division of the shekel see Ungnad, *OLZ.* Beih., ii, 26, but it does not seem to be a satisfactory explanation, since it can be made out to be $\frac{1}{8}$, $\frac{1}{6}$, and $\frac{1}{2}$ of a shekel by these calculations. As he says, 'Dass man aber derartig ungenau rechnete, wirft ein nicht sehr günstiges Licht auf das babylonische Rechnungswesen'.

glass contains 6 to 10 per cent. of lime, 15 to 20 per cent. of soda, and the balance silica: in faience the silica varies from 94 to 99 per cent., the lime is generally about 2 per cent., whilst soda, when present, is often from $\frac{1}{4}$ to 1 per cent.: 'Glass is made by heating the ingredients in a crucible until they are liquid and the materials dissolved, when it is either poured out as a liquid into a mould, or pulled out as threads when in a plastic condition, or else allowed to cool and then is broken from the pot'. Frit is a chemical compound, a double silicate of lime and copper. Glass occurs in Egypt in pre-dynastic times (perhaps 4000-3500 B.C., *ib.* 9), and a little later perhaps in Mesopotamia than in Egypt, the specimen, from Tell Asmar, being of pale green colour, and the date claimed being 2700-2500 (*ib.* 10). This latter date would appear to be reasonable, from the description of the provenance of the glass as given by the finder, Dr. Frankfort. Another piece, also ascribed to the same date, but perhaps not with such probability, was found by Hall at Abu Shahrain. This is described by Beck as a block of pure blue glass, which was probably a manufacturer's piece of material, and is thus the earliest suggestion of a glass factory known (*ib.* 11). Following this date the specimens are from Egypt until possibly 2100 B.C. (the date is uncertain), after which is one from Ur.¹ Beck's researches into glazed stones (*AE.*, Dec. 1934 and June 1935) show that the custom of glazing stones and beads existed both in Egypt (greenish blue, with true glass, pre-dynastic), and Mesopotamia (Ur, presumed 2300 B.C., transparent, and Nineveh, presumed 2900 B.C., a glaze of red copper).

The analyses of Egyptian glass (*AEMI.* 421) of periods between the XVIIIth Dynasty down to the first century B.C. and the Alexandrine period show that the amounts of silica ranged from 50.9 to 68.5 per cent., of lime 1.5 to 10.7 per cent., of soda 9.0 to 29.0 per cent., and of potash 0.1 to 7.6 per cent. Other substances included in small quantity were magnesia, oxide of lead, of tin, of copper, of manganese, of iron, of aluminium, and sulphur trioxide (many of these being the colouring agents). For a Roman lachrymatory Dillon (*Glass*, 9) gives: silica, 71.5: soda, 16.5: lime, 8.0: iron oxide, 1.0: alumina, 2.0 per cent.

Two analyses of Babylonian glass of the Kassite period (*c.* middle of second millennium) show:² for *lapis*, silica 65.03 per cent., lime 5.65 per cent., sodium monoxide, 17.37 per cent., oxide of magnesia, 2.52 per cent., with small quantities of other substances; and for *turquoise*, 64.41, 6.19, 13.98, and 5.59 per cent., respectively. Three pieces of the same date analysed by Darmstaedter (Ruska, *Stud. z. Gesch. d. Chemie*, 1927, 5) give the silica as 57.78 per cent., lead monoxide 15.83 per cent., and sodium monoxide and potassium oxide together 16.98 per cent., besides small quantities of other substances. In later Babylonian glass

¹ Of uncertain date, but perhaps 2100 B.C., *ib.* 17.

² So Neumann (*Z. f. angew. Chem.*, 1929, xlii, 835), quoted *ODAC.* 287.

(c. 250 B.C.) the proportion of silica is higher (so Neumann, quoted *ODAC.*, *l.c.*).

Fowler (*Arch.* xlv, 1881, 79) says that on the shores of the Mediterranean from the twenty-fifth to the ninth century B.C. an opaque or porcellaneous glass was fairly extensively manufactured; from the ninth century to the sixth century B.C. in the countries bordering on the east Mediterranean (and west, somewhat later) a translucent or horny glass, and from the eighth century B.C. to the sixth A.D., a perfectly transparent glass was made. From the fourth to the seventh centuries A.D. Constantinople appears to have been a home for the art of making crystalline glass (*ib.* 93), and Fowler thinks that it is not impossible that, when Venice sprang into existence in the fifth century, the knowledge may have made its way thither at the same time (*ib.* 94).

§ 6. *A cuneiform Glass-text of the seventeenth century B.C.*

One of the most important texts in the history of practical chemistry is B.M. No. 120960, a baked clay tablet inscribed in cuneiform, $3\frac{1}{4} \times 2\frac{1}{16}$ in., dating to the reign of Gulkishar, not later than the seventeenth century B.C., said to have come from or near Tell 'Umar (Seleucia). It was written by one Liballit (?)-Marduk, the son of Uššur-an-Marduk, a priest of Marduk at Babylon, who may be said to be the first known glass-maker. It contains the earliest record of formulae for the making of glaze with copper and lead for pots, and for making a green body with clay mixed with verdigris, and not the least interesting part of it, as has already been mentioned, is that it anticipates the cryptic jargon of the later alchemists, whereby the writer hopes to conceal his knowledge from ordinary laymen, keeping them secret by his cryptograms except from the initiated of his Guild. The exact procedure will be found in Appendix II.

During his work he does not forget to placate the forces of the unseen world, here described by the embracing term 'the dead man', which will be presumably the same as the embryos which play so large a part in the later Glass-texts (see next Section). The 'dead man' is to be covered with *bašamu* ('spices'), a frequent burial-ceremonial in the ancient Near East, which may have been either the 'aloes' of the Old Testament, or the Arabic *bešem* (the well-known balm of Mekka, Chesney, *Exp.* i, 601).

It is a unique text, and deserves a full study for the numerous different lights it throws on the history of chemistry. The next cuneiform texts are those from the Library of Nineveh.

§ 7. *The cuneiform Glass-texts of the seventh century B.C.*

There is a gap of a thousand years before we come to the next glass tablets, when we reach the collection made by Ashurbanipal

(668-626 B.C.).¹ These tablets, some of which were devoted by him to the Temple of Nabû in Nineveh, from what we know (now that all probable 'joins' seem to have been made) were written in four editions or recensions on tablets divided up into one, two, or three columns.² No single author or inventor claims to have made this collection, but one of the recipes is said to have been from the hand of *Nûr* (?) . . . , and another [from the hand of?] . . . -*daiâni*.³ This, with the previous name Liballit- (?) -Marduk of the seventeenth century, represents our present knowledge of the names of the earliest Assyrian glass-makers.

The contents of these interesting texts are: the method of making the furnace: the necessity for ceremonial purity in the work: the presence of embryos, as incomplete bodies whose spirits are to be placated by offerings (like the 'dead man' in the preceding section), so that the glass-recipes may be brought to completion:⁴ the fuel to be used: and then numerous recipes for making and colouring glaze.

In the first section the furnace is called *kûri ša abni*, 'furnace for metal', doubtless including the two different kinds of furnaces mentioned later. *Bît kûri* 'house of the furnace' is mentioned in one text, but it is not certain whether this refers to the actual house in which the furnace is

¹ Virolleaud, *Babyloniaca*, iii, 221, was the first to publish one of these (K. 203, as it was then, without its present 'joins', and without translation). Bosc (Fr., 59) essayed a translation of this, and then Meissner from Zimmern's copies made a translation of the sections 'A', 'B', 'C', and 'T', and part of 'H' (*Bab.-Ass.* ii. 383, 1925), but his methods of identifying the components at that early stage of pioneer work in this field could hardly help a practical chemist. Helped by the list of fragments given by Zimmern to Meissner, I published the greater part of these glass-texts in 1925 (in my *OTC.*), almost at the same time as Zimmern, who, as I had learnt while working on them, had been studying them simultaneously. His edition appeared in 1925 in *ZA.* xxxvi, 177 ff., and, as we should expect from the pen of so distinguished a scholar, it was an admirable academic translation, although it gave little to explain the unknown chemicals. He, however, knew of three more fragments than I, and now, with these, as well as two others which I found in working over the Gilgamesh fragments, and another in the Medical Texts, and three most generously pointed out by my old pupil Dr. F. W. Geers, I have given a *résumé* of the recipes in Appendix I. For a photograph of K. 203 as it now is, with its different fragments re-joined, see Holmyard, *Makers of Chemistry*, frontispiece. I hope to re-publish the whole series again.

² This does not include K. 6920 and K. 7942, which may form part of another class of chemical tablets.

³ It is possible that these two fragmentary names are the beginning and end of the same name. *OTC.* pl. 5, iv, 17 gives *e-lam-me-te ša katâII m Nûr*(?) . . . , and *ib.* v, 19-20, *e-la-me-te ša*(?) *katâII*(?) . . . -*daiâni*.

⁴ This custom of placing embryos in a furnace would appear to find an echo among the later glass-makers of Constantinople. Fowler, *l.c.* 93, quoting Evagrius, *Hist. Eccles.* iv, 35, says that as far back as the Episcopate of Bishop Menas, A.D. 531-65, a child was shut up by his father (a Jew) at Constantinople *in cilibanum ardentem in quo vitrum formare solebat*.

built, or to a part of the furnace itself. The place for the fuel is naturally described as *šaplita kûri* 'the under part of the furnace'.

There appear to be two distinct furnaces: the one used first is described as *kûri ša šiknat ênâte* ¹ *-ša* 'furnace with a floor of eyes',¹ and the second, used in subsequent processes, is called *kûri ša dakkanni* or *dukkanni* 'furnace of the arch (or, perhaps, dome)'.² In this latter there is a *bâb kûri* 'door of the furnace', through which the 'metal' is introduced. Mr. Pilkington has been so good as to describe the two probable kinds of furnaces represented by these Assyrian terms:

'As I understand it, there are two kinds of furnace, the one with "eyes" in the floor, and the other described as having an arch or vault as part of its structure.

'I think that the furnace with the floor in which were "eyes" was probably a high-temperature furnace, such as would have to be used for the chemical re-action, and to refine the glass (as far as this was ever attempted).

¹ A picture of an Assyrian furnace of this kind at Ashur, with the 'eyes' visible is published by Andrae, *Coloured Ceramics*, fig. 37 (cf. Darmstaedter, *Arch. f. Gesch. d. Mathematik*, Bd. 10, 1927, 72, ff.). Mr. Searle tells me that they are still called 'eyes'. I must adhere to my translation 'floor of the apertures', as against Meissner (in einen Ofen) 'dessen 4 Augen (?)' (kalt sind).

² *Dukkannu* (once, *OTC.* pl. 3, l. 99), but more usually *dakkannu*. Meissner and Zimmern were right in seeing a noun in this and I was wrong (*OTC.* 74): Zimmern, quoting *Shurpu*, viii, 59, and the *Ur-ra* -myth, makes it 'etwa die "Brennkammer"': Meissner 'Innenraum'. But we have already *šaplita* as the lower part where the fire is: above this is the 'floor of the eyes': hence *dukkannu* must represent another part of the (or, a) furnace. Now in *CT.* xviii, 42, i-ii, 1-3, the group beginning [*nu*]-*ša-bu*, [*da*]-*kan-nu*, indicates probably some connexion of *dakkannu* with a dwelling place. The Sumerian for *dakkannu*, *KI. GIŠGAL* (with the value *daggan*) (*D.* 461, 47) can be explained as *KI* 'place' and *GIŠGAL*, either *manzazu* 'standing place', or *mehê* 'storms', and since *GIŠGAL. LU* (*D.* 49, 10) is also *îpu* 'cloudy', the meaning suggested is the 'vault' or 'dome of heaven', where the clouds gather. The *Ur-ra*-passage (*K.* 2619, Harper, *BA.* ii, 485, 517, and Jensen, *KB.* vi, 66, augmented from *KAR.* 169, r. iii, 16-17) runs *ši-e-bi ina ddk-kan-ni tuš-[a-mit], ardâti¹ šîrûti¹ ina ur-ši-ši-na tuš-ta-m[it]* 'The old men in the *dakkannu* thou slayest, the maidens (and) young men in their bed-chamber thou slayest' (or possibly *šîrûti* should be *šîrêti*, agreeing with 'maidens'). *Shurpu*, viii, 59 runs *itti mamit urû nanzabu sippu šîgaru daltu sikkuru u dakkannu*, &c. 'from the tabu of fence, support (rail?), threshold, lock, door, bolt, and *dakkannu*'. Particularly must we notice *KAR.* 192, r. ii, 52, *ZID di-ig-me-ni ša duk-kan* 'Powder of ash of the *dukkannu*'.

Now the Arabic *dukkân*, properly 'a shop', is usually applied to the *arched* recesses or alcoves of any bazaar in which the shopkeeper sits, and this seems probably the cognate word to which to refer. *D(t)akkannu* (*d(t)ukkanmu*) thus defines a special furnace used in procedure subsequent to the first melting in 'a furnace with a floor which has eyes'. It is a word connected with building, with some similarity to the 'dome of heaven'; philologically it would appear to be connected with the Arabic *dukkân* a shop, those arched recesses in eastern bazaars. Everything points to its meaning 'arch'.

'I think that this furnace must have been of conical shape, with its outlet at the top, and containing a floor pierced with "eyes", beneath which was the fuel. This furnace could be made to reach a good temperature, say perhaps even $1,000^{\circ}$ to $1,100^{\circ}$ C., and the secret of its success would be its height and the shield of flame round the centre space in which the articles to be heated would stand.

'The other furnace is described as "a furnace with an arch", and this, I think, may be explained by its structure, in this case arched, being lower than the first furnace, while the exit-point of the flames may have been at the side (but this last is not necessary). In this case the furnace would not heat up to so high a temperature as the first, and as I understand that it was employed for a second operation after the first furnace described above, I think that it may either have been a re-heating or even an annealing furnace. The chief *desideratum* of such a furnace would be probably the exclusion of air-draughts, and its reduced height would decrease the tendency to indraught by suction considerably.

'It may seem strange, but, the temperature of the flame being almost the same in each case, the performance of the heat-interchange is very different in the two cases, owing to the contrast between the rapidity of passage and freedom of exit in the high furnace with eye-holes in the floor in the one case, and the devious and eddying course of the flame in the other.'¹

There is a poetical comparison of the cosmos to a smelting furnace in an Assyrian text (see p. 75), where the fire is apparently the red sky below, fanned by the winds: the 'thunderbolts' (*saggilmūt*, nodules of iron sulphide) represent the metal, and the clouds the pompholyx in the dome.

The fuel is *šarbatu*-wood, almost certainly styrax, or, if not, some similar gummy wood (*AH.* 133, not mulberry, as Meissner, *MVAG.* 1913, 261), cut in the hot month of Ab, the logs² not bound up in bundles, but kept under *api* of hide³ (probably coverings). Nowadays all fuel is expensive in Mosul, and the fuel for large undertakings such as making pots or burning lime is chopped straw. The great plantations of *šarbatu*-wood were round Harran in Sargon's time (see Johns, *Liber Censualis*). Mr. Searle has pointed out to me that I was wrong in *OTC.* 72 about the comparative heating power of coal. He says that wood produces a better glaze than coal.

The fire is kindled (*napāhu*); it may be a good fire (*išatu ṭābtu*), not

¹ For a limekiln see Frankfort, *Tell Asmar and Khafaje*, 1930-31, 90, and for a smelting furnace, Woolley, *The Sumerians*, 149.

² *Ḳurū*, Heb. *kōrāh* 'board, timber'.

³ *mašku Api*. I took this in *OTC.* 72 to be cognate with the Syr. *āphūthā* 'cloak', and to mean 'leather coverings'. Meissner translates 'Säckchen (?)', Zimmern 'Lederriemen', and Eisler (*Chem. Zeitung*, July 1925, 577) 'Säckchen'. Inasmuch as a large quantity of wood would be necessary, I take it that the coverings would be like the modern tarpaulins, stretched over great stacks of the wood.

smoky (*la ʕatirtu*), or a fierce fire (*išatu dannatu*); and it (rises) 'from the midst of the eyes'. The fire is 'drawn' (*šadādu*), and the furnace cooled: for one firing (two examples) instructions are given for the fire to burn for seven days; or the furnace may be opened after four days, or even ten days. The materials for the glass (frit) are crushed (*ḥašālu*, *marāku*), but it is not entirely clear whether *bullulu* (especially in iii, 2), *tultabal*, means both 'mix' and 'melt' (*billu* and *abnu* are both used to indicate the mixture or 'melt'). The mixture is put into a clean melting-pot (*ṭaptu zakutu*): or into a mould (*tamšiltu*), which may be closed with a duplicate (?) (*tašne*), or have its base (*išdu*) covered (*ešū*): or in a pan (?) (*ḥaragu*), not closed (*la ešete*), closed (*ešete*), 'covered, but not closed' (*šaktumte la ešete*). The *ṭaptu* may be rested on a support (*nimeḍu*, stilt?), so that it does not touch the furnace. The 'metal' is 'put down' into a furnace which has a 'floor of the eyes' (and settled (evenly)) 'between the eyes'; subsequently it is put into a reverberatory furnace ('furnace with an arch'). The 'metal' is kept in the furnace until (a) it melts (*šādu*); (b) it 'turns' (?) (*ubbuku*); (c) it turns red (*rašāšu*); (d) it turns yellow (*ḥarāšu*); (e) it turns white (*pišū*); (f) it bubbles (*raḥātu*, the Syr. *r'thal*); (g) the fire 'from the middle of the eyes' may drive out the bubbles (*šiblukku*, Syr. *šūlbāgē*); (h) the 'metal' may 'speak (like?) *zikzikū*'; (i) the ingredients amalgamate (*kapālu* 'twist', 'writhe'); (j) the metal may be taken out and cooled; or (k) the furnace may be allowed to cool before the 'metal' is taken out (the door being sometimes left open); or (l), as in making *šipru* 'sapphire', the metal is cooled by pouring into water. There is a rake (*mutirru*, Zimmern 'Haken', which must be the Syriac *mattārā* or *māthōrā*, rutabulum, doubtless taken over by the Syrian glass-makers from Assyrian), with which the 'melt' is agitated (*baḥāšu*, Syr. *b'ḥaš*, and perhaps another verb, 2nd person singular, with similar meaning, *tada'ib*); a ladle (?) (*su'lu*); and what may be a tray (?) or slide (?) (*malanu* (?)), by which the 'metal' can be agitated. There are two unknown words, *tamrata* (spoons?), and *uraku*.¹

§ 8. *Recipes for making glass in Assyria in the seventh century B.C.*

The following are the recipes for the various glazes and glasses in the Assyrian texts of the seventh century (Appendix I gives the full list of components of each in order).

(B) is a simple glaze to be poured on brick (10 parts sand (No. 2 (o)), 15 parts ash of alkaline plants (No. 1 (o)) and 1½ parts *styrax (or similar, ²UD, AH. 135)). Crush separately, mix, put into a cold furnace with

¹ The more modern tools in use, as given by Blancourt, *Art of Glass* (1699, 22 ff.) were a ladle, shovels, fork, and rake, with moulds of marble (*ib.* 32). For *uraku* cf. 'S' 36.

a floor of 'eyes', settling it between the 'eyes'; keep a good, clear fire until the metal reaches white heat: take out, cool, crush again, put in a clean melting-pot into an 'arched' furnace with a good, [clear] fire until it again reaches white heat, and then pour on the brick.¹

A note is necessary on ^uUD. It occurs in . . . ^uUD šá mē iA.TU. GAB.LIŠ šum-šu . . . ^uUD whereof the meaning is "water of the šarbatu-tree" (AM. 40, 5, iv, 3): soluble in heat (?), AM. 41, 1, 26. A.DAN (hīlu), 'gum', of ⁱšarbatu is more common than simple A 'water'. The šarbatu-tree grew round Harran, and consequently is probably the same word as the *strobos* or *storbus* of Pliny (NH. xii, 40), an odoriferous gum from Harran. (For other details see AH. 135.)

There are two possibilities for it here: (1) it might take the place of the more modern gum-Arabic,² used to make the glaze adhere, but this seems almost impossible, since firing takes place after the mixing; (2) it might be used possibly as a component to prevent too great a proportion of sandiver or scum (for such, see TC.ii, 584). 'Digmenu (ash) of ⁱšarbatu' is applied to the uterus, KAR. 194, r. iv, 9, and LA of ^uUD (presumably ash, no. 2 (i) of *styrax) is used for eyes (AM. 92, 8, 8), so that it is possible that a charcoal is here suggested. EC. 682 speaks of an experiment by Fuchs of a melt of 10 parts pearlash, 15 parts quartz powder, and 1 part charcoal, ignited in a refractory crucible for six hours, pulverized, added in small portions to boiling water until dissolved, and then evaporated ultimately to a solid, which resembled common glass, but was much softer and more fusible.

There are three kinds of glass or glaze called *širšu*, *dušū*, and *zūkū*. *Zūkū* (D) is a clear glass (*zakū* 'be clear') which is presumably the *zuka(k)-i* of the seventeenth-century text (§ 6) made of an unknown quantity of sand and 12 mana of *aḥussu*, for which last I have no explanation, and can suggest only that it is a simple glaze like *zagindurū* (B). Crush [separately, mix], put into a cold furnace with a floor of 'eyes', settling it between the 'eyes'; keep a good, clear [fire] burning, until the melt turns dull red and (then) white (?),³ cool; [crush] it again, put into a clean melting-pot, put it into a cold 'arched' furnace, (melt) with a good fire . . . , pour on [the brick].

Širšu (CC), as well as *širšu natku* (P), and *dušū*, 'crystal', (T, BB) are described in No. 18 (c). Various coloured glazes are made up with these with different colouring agents added, of which the best known are the black and red copper oxides (No. 7 (b) (2)). *Uḫnū*, a simple blue glaze

¹ Neri (Merrett, 8) gives for 'Crystall Fritt' 200 lb. of tarso (silicious stone) 130 polverine (alkali) mixed, put into the Calcar which must be well heated 'for if they be put into the Calcar when it is cold, Fritt will never be made of them'.

² Suggested to me by two persons independently. This method is described in *Hist.* ii, 81; with tragacanth as the gum, moistened in water and crushed with a glaze, and applied to the pot before baking.

(F), consists of 10 parts *tersitu* (a composition of equal quantities of black oxide of copper and *zuku*-glass, (C)) 10 parts *siršu* glass, some alkali, $\frac{2}{3}$ parts of 'lime of the sea'¹, and some roasted *sându* (litharge, p. 125). Crush separately, mix, put into a cold furnace with a floor of 'eyes', in a [clean] melting-pot, between the 'eyes' on a stand, so that the base of the pot does not touch the furnace; drive out the bubbles with a good, clear fire, and when the 'mix' is melted, draw the fire, and take it out and crush when the furnace is cooled. Put it again in a clean melting-pot into a cold 'arched' furnace keeping a good clear fire (but with the furnace-door open), until the metal is red, and then shut the door, agitating it until the metal turns yellow,² and when the metal turns (?), pour it into a closed melting-pot, and when the furnace is cool it will be ready.

There are at least two recipes for making *uknú merku* (apparently 'moulded' blue glass),³ and there may be five. Section G gives 60 parts of *tersitu* (black oxide of copper and glass), 20 of crushed *siršu*-glass, 20 of sand, $\frac{1}{12}$ part of lime, all of which is to be mixed, again crushed, put into a mould which is to be closed with another mould (?), and set between the 'eyes'. Sections H and K appear also to have been for *uknú merku*, but as they each contain an unknown substance, they demand a full discussion:

(H) is composed of 100 parts *tersitu* (black oxide of copper and glass), 300 parts *tarabanu šadda*, $\frac{5}{18}$ part *siršu*-glass, . . . $\frac{5}{36}$ part lime of the sea, . . ., something of *sândi* (litharge, probably), $\frac{1}{18}$ part saltpetre, 5 parts *šīpu*-arsenic, $\frac{5}{36}$ part male red alum, $\frac{1}{6}$ part *lêru*-arsenic, 10 parts *styrax. 'Keep a fire burning for seven days in the furnace', (melt), crush again, put into a mould.

Mr. A. B. Searle courteously pointed out to me that my suggestion in OTC. 53 that *tarabanu* was 'manganese' could hardly be right, because of the enormous proportion. He suggests (1) ashes of some plant; (2) some prepared material; (3) a coloured glass or glaze. We may eliminate (3), since we already have the colour in *tersitu*, and we shall probably find the explanation in (1) in some form of soda. (2), as some prepared composition, is improbable, as the texts afford us no indication of this, and they are concise in their details of such compounds (*tersitu*, *zuku*, *siršu*, *dušû*).

Tarabanu, however, can hardly be the ashes of a plant, for three reasons; (a) there is no plant-determinative, such as is actually given to *šarbatu in this receipt; (b) *tarabanu* is not found as a plant name in the

¹ Neri (Merrett, 271) says that Ferant. Imperatus commends lime made of *pisces crustacei* and *testacei*, such as oysters, crabs, and lobsters.

² Text a little broken and doubtful.

³ *Merku* I have taken to mean 'moulded', from a root *erêku*, with which we may compare the Late Heb. 'ārak 'to mould bread'.

voluminous plant lists; (c) the *uhulu*-salicornia is so admirable for making glass that it would hardly seem necessary to introduce a new kind of potash.

Again, it can hardly be a form of sand of a peculiar quality, since we have already the *immanakku*, the special kind used constantly.

The truth probably is that *tarabanu* is a very common chemical which has not yet been included in these glasses, the mineral carbonate of soda, nitrum. While 'Bohemian glass' is composed chiefly of silica (100 parts), pearlash (50-60), and carbonate of lime (20-35), 'spread glass' is different in the proportion of soda included, of which a considerable quantity is used in the latter (*EC.* 682). If we presume that *tarabanu* is soda in large proportion in this glass, we can also admit the presence of potash, already included in the composition of *tersitu*, which is an advantage: 'a pure soda-glass melted and blown rapidly is apt to get stains on the surface . . . but if one-third or more of the alkali be potash, the stain is rarely observed' (*ib.* 683). 'Crown' glass would appear to be very similar to our *uḫnū merku*, being composed of 100 silica, 60 soda ash, 8 potash, 10 lime, 4 saltpetre, $\frac{1}{2}$ arsenious acid (*ib.* 683).

Naturally Egypt, where the natron lakes have provided carbonate of soda from time immemorial, affords glass with a large proportion of soda to potash, *AEMI*. 419, 422 giving many analyses, of which I may quote two to show the percentages: (a) XIIth Dynasty, silica, 68.3: potash, 2.0: soda, 20.2: (b) Fostat, silica, 71.2: potash 2.1: soda, 11.4 (with other ingredients to make up the quantity). The natron, as analysed by Lucas (*ib.* 228) often contains impurities which are apparent in the ultimate results in the glass-making (*ib.* 120), and hence, if we should consider *šadda* to mean 'purified', in its sense of 'to draw' (even 'to rake out' a fire), our proportion of *tarabanu*, when purified, might well work out satisfactorily as soda or natron. Philologically the word can be compared to the Arab. *turāb* 'earth', perhaps here indicating the special kind from which the carbonate of soda came, and it is conceivable that the word *trona* which comes from the Arab. word *ṭrōn* (said to be abbreviated from *natrōn*) owes its origin to our *tarabanu*. The directions for 'scraping' the soda in the making of this chemical in the Introductory Section of Ar-Razi's *Kitāb al-Asrār* (*MASB.* 376) suggest that *šadda* may show the same process: 'Take 1 *mann* (2 lb.) of white pieces of *Al-qili* and powder it, and pour on to it 7 times its amount of water. Leave it for 7 days, and then put it into a pot and subject it to coction until it is reduced to half (its volume). After letting it rest, filter it ten times and put it into thin glass cups (*kizān*) and hang them in beakers (*jamāt*). Scrape down whatever first crystallizes out in the cups, and return it to the solution. Protect anything that drops down into the glass beakers from dust. Scrape off whatever crystallizes out the second or third time, and take it out, until all will have turned into salt, if it

A third and probably fourth way of making *uḫnū merku* is with one part of *tersitu* to which are added either $1\frac{1}{2}$ (as in L) or 2 (as in K) parts of *šadā*. This last substance occurs here only (and not in Sect. AA, where I still read . . . -*ad-da-a*, against Zimmern, *l.c.*, 200). Mr. Searle tells me that my suggestion for ferric oxide for *šadā* (OTC. 55) cannot stand, since the proportion in Sects. K and L would be so large as to prevent fusing at temperatures obtainable with wood. It can hardly be an additional form of glass, as we have no other mention of it in these texts, nor can it be a colouring agent, which is contained in the *tersitu*. It must be some simple additional component to the glass, possibly an additional silica, and, since *šadā* will properly mean 'mountain', I suggest very tentatively, in view of what Mr. Searle tells me, 'quartz' or 'flint'.

Sect. J, the last way of making *uḫnū merku* (?) increases the amount of glass which is already in the *tersitu*: 900 parts *tersitu*, 2,400 *zuku*-glass, 450 parts ^a[*šad*]*ā* (?), 1 part saltpetre.

From these we can go on to 'sapphire', *šipru*, which varies little, except in the firing, from simple *uḫnū*. It consists of equal parts of *tersitu* and *siršu* glass; 'crush together, put down into a cold furnace, keep a good fire burning until they amalgamate: put down in an 'arched' furnace, in a covered, "not closed" *ḥaragi*-pan, fire, and pour the melt into water: put down in a closed *ḥaragi*-pan, close up the furnace tightly, open after four days'.

Section S, 'green crystal' (*dušū arḫu*) is uncertain, as we do not know what the first components are: 'Ditto (?), to *ĀŠ*. *GE*₄. *GE*₄-arsenic . . . : again put into a mould: close the base of the mould, put it on [a support?] in the furnace: close the furnace seven days . . . on the tenth: take out and add 3,600 parts of ^a*ba-aš* (?) . . . , and 1 part each of washed saltpetre, lime, and potash, and some washings of spodos: crush again, rub, and melt (?*tultabal*) . . . (uncertain), let the fire burn, and take out.'

For two recipes dealing with what may be opaque glass see p. 72.

§ 9. *The use of gold in glass (almost the Purple of Cassius), and the possibility of the knowledge of aqua regia among the Assyrians*

Lastly we come to the most interesting recipe of all, Sect. DD, to make '[red] co]ral', [*ba*]*hrē* (No. 43), by the inclusion of an infinitesimal amount of go[*ld*], with certain impure metals (which might possibly contain tin), which may represent the Assyrian prototype of the Purple of Cassius. Two problems, however, confront us: first, the text is badly mutilated, and although still searching for the lost piece, or a duplicate, in the Kouyunjik Collection, so far I have found none; secondly, if the recipe actually includes gold, we have to prove a knowledge among the Assyrians of *aqua regia*.

First, with regard to the text itself; we can see in the recipe as

components, 7,200 parts of *zuku*-glass; 32 of [*tus*]*kū* (spodos, impure oxide of zinc); 20 of *aba*[*ru*] (which at an early period is lead, but in later times we find the 'needles of *abar*' as definitely antimony, and *anāku*, hitherto often tin, taking the place of lead); an unknown quantity of saltpetre, and 1 part of *KŪ* . . . (which can only be (a) *KŪ*. [*GI*], gold; (b) *KŪ*. [*BAB-BAR*], silver; or (c) *KŪ*. [*PAD. DU*] (of No. 1 (*m*)), which is practically impossible. Indeed, it is the infinitesimal quantity of *KŪ* . . . (1 in about 7,250) which makes 'gold' almost certain, since there would be no point in introducing so small a quantity of any other substance.

Now an infinitesimal quantity of gold, when dissolved in what was known as *aqua regia*, will give a red colour to glass, a process known before the discovery of the Purple of Cassius in the seventeenth century (wherein, using the gold thus, chloride of tin was added). We are not concerned with the latter addition, which is probably not included in our recipe: it will be enough if we can prove that the Assyrians were able to use gold in glass after a dissolution by *aqua regia*.

Roscoe and Schorlemmer (*TC*. 5th ed. ii, 588) give the following historical details about this use of gold: "The older chemists were acquainted with the fact that glass could be coloured a ruby-red tint by means of various gold compounds. Thus Neri describes a method of preparing ruby glass by adding to the glass-maker's materials the residue from the evaporation of a solution of gold in *aqua regia*.' (Neri's method (ed. Merrett, 192) gives it as follows: 'Calcine Gold with *Aqua-regis*, many times, pouring the water upon it five or six times, then put this powder of Gold in earthen pans to calcine in the furnace till it become a red powder, which will be in many days, then this powder added in sufficient quantity, and by little and little, to fine Crystall glass which hath been often cast into water, will make the transparent red of a Rubie as by experience is found.') (Pomet (1737, *HD*. 108) evidently quotes the above from Neri almost word for word.)

TC. (588) goes on to say that general attention, however, was drawn to this subject in the seventeenth century, after a discovery of the *purple of Cassius*, obtained as a dark red powder by mixing the chlorides of gold and tin. 'In his *Ars Vitriaria Experimentalis* he [Kunckel] says: "There was a certain *Doctor medicinae*, by name Cassius, who discovered the *praecipitatio Solis cum Jove*: to this perhaps Glauber may have given occasion, but I leave this undecided" (*ib.* 589). The amount of gold contained in ruby glass is very small, amounting to 0.05 to 0.06 per cent.' In our Assyrian text it is about 0.014 per cent.

Let us consider first, as briefly as possible, the history of *aqua regia*. Lowry, in his *Historical Introduction to Chemistry*, 13 ff., gives it so admirably that I have ventured to quote him, compressing it as much as is advantageous for our purpose. The first powerful acid to be discovered was oil of vitriol which can be obtained by distilling green vitriol (from

decomposed pyrites), as described in the writings of Basil Valentine and Glauber, although actually it was obtained as far back as Geber (eighth century A.D.) from the distillation of alum. Green vitriol was certainly known to the Assyrians, who called the green vitriol by the name *“ZUR.ŠAR.GUB.BA* ‘decomposition of pyrites’ (No. 9 (c)). From this distillation of green vitriol, as Lowry goes on to say, dense white fumes result from which the oil of vitriol is obtained. This, too, the Assyrians knew, for their word *“ZUR.ŠAR.GUB.BA* is immediately followed in a syllabary by *amarhušum* (probably connected with our word marcasite, pyrites), which is actually equated with what, I venture to think, is the most important word in Assyrian chemistry, which, as I have tried to show in No. 9 (e) (2), was their word for ‘fuming sulphuric acid’. The word is actually *hannabahru* ‘fuming *hanna*’ which I take to mean, from a comparison with other Semitic roots, ‘fuming fetidity’. Then Lowry says that the result left behind after distilling the green vitriol is colcothar, red vitriol, which the Assyrians knew quite well under the form *“ZA.SUH.DIR* (No. 9 (d) (4)) and, since they knew both green and red vitriol, naturally there can be no doubt that they had the intermediate product, the ‘fuming sulphuric acid’, the oil of vitriol.

So far so good. But we are unacquainted as yet with any acid stronger than oil of vitriol known to the ancient Assyrians.

Geber, however, describes another acid (*aqua fortis*) obtained by distilling a mixture of saltpetre and green vitriol and alum, which Glauber at a later period obtained more easily by distilling a mixture of oil of vitriol and saltpetre from a glass retort heated gently in a bath of hot sand over a furnace. But in addition to this, by dissolving sal ammoniac or salt in *aqua fortis*, Geber obtained the more powerful *aqua regia* capable of dissolving gold. This is the acid which is essential for dissolving gold to make red glass, and it is this which the Assyrians must have had, if the recipe, which has been quoted, really contains instructions for this process.

Hoefer (*HC.* i, 117) has already suggested that even as far back as the time of Pliny *aqua regia* was known, since in *NH.* xxxiii, 25, the latter says that gold is put into an earthen pot with 2 parts of common salt, 3 of misy (sulphate of iron or copper), 2 of another salt, and 1 of a stone called schistos (argillaceous earth), and then heated, by which process the gold will be freed from impurity. Hoefer says that this passage is of the highest importance for chemists since a mixture of common salt, vitriol (sulphate of iron or copper) and clay produces under the influence of heat a reaction from which will result one of the most powerful mineral acids. ‘Quel était’ (says he) ‘cet autre sel que l’auteur ne nomme pas? Si c’est le nitrate de potasse, les Romains auront connu l’eau régale. Or la vraie chimie ne date que de l’emploi bien établi des acides minéraux, qui sont les véritables dissolvants des métaux.’ (But *v. CS.* i, 204.)

As I have already said, we are not concerned with the introduction of tin into the Assyrian gold mixture, as in the Purple of Cassius; the red result from gold in glass can be obtained without it, according to the above authorities, and our only concern, at all events at first, is to discuss the possibility of the Assyrians knowing the necessary acid *aqua regia*.¹ They certainly had all the ingredients, the most difficult to obtain being the fuming sulphuric acid, which, I think I have shown, they knew under the name *ḥannabāḥru* 'fuming fetidity', from the decomposition of pyrites. Saltpetre (*mil'u*), salt (*tābtu*), sal ammoniac (*ītru*, *ītrānu*, *IM. KAL.LA*), and alum (*gabū*), too, if necessary, were all easily available.

Now our text, having given the proportions as stated above, goes on to say that this is the *elamete ša* (?) *ḫatāii*(?)[^m] . . . -*daiāni*, an indication that it is the discovery (?) (Arab. 'ilm 'science') of a certain chemist called . . . -*daiāni*. One other recipe (Sect. U) uses a similar phrase after the details of the ingredients, and then comes to an end. But ours appears to have several more very broken lines before it reaches the name of the result [*ba*]ḫrē ('[red co]ral'), and it will be in these broken lines, if anywhere in cuneiform, that we must seek the description of *aqua regia*. We are entitled to look on these lines as a kind of 'rider'

¹ I append for convenience the formulae for making ruby glass with gold and tin. It will be observed that in the Assyrian recipe the difference, except in the quantities, is that [*tus*]kū and *aba[ru]* replace the borax, tin, and antimony (presuming, as we are entitled to do, that the *zuku*-glass represents the silica, lead, and potash). Two methods are given in *EC. 684*: (1) dissolve 1 part of gold in 18 parts of *aqua regia*, dilute it with 5 times its volume of water, and add $\frac{1}{2}$ of the solution to 512 parts of the following glass-paste:

- 100 parts of silica
- 160 parts of oxide of lead
- 20 parts of purified potash
- 20 parts of saltpetre
- 48 parts of borax
- 3 parts of oxide of tin
- 3 parts of oxide of antimony.

The mixture is heated for 12 to 14 hours in an open crucible; (2) (another method) dissolve 1 part of pure gold in 12 parts of nitric acid and 12 parts muriatic and 1 part sal ammoniac, and add to it 1 part of tin dissolved in 20 parts of nitric acid and 6 parts muriatic, and diluted in a flask with 500 parts of water. This purple precipitate of Cassius is filtered, washed, and dried, and added in small quantity to the following mixture:

- 40 parts of quartz
- 16 parts of saltpetre
- 8 parts of borax
- 1 part of arsenious acid
- 1 part of cream of tartar

the whole being heated in a glass pot until it has attained a low redness, when it is covered and a higher heat given. When clear the glass is cooled, pulverized, and sifted, and mixed with a sifted glass composed of 128 parts of quartz, 64 of

explanatory of the method which . . . -daiâni used to dissolve his minute quantity of 'go[ld]'.

The lines are so important that, mutilated as they are, and with all reserve in my suggested restorations, I think it well to append them in full. It will be seen that saltpetre is easily visible at the end of l. 22: the crux is in l. 23, which ends with . . . -ba. Now we might see in this . . . -ba the end of *namrûtu ša A. AB. BA* 'lime of the sea', one of the substances in use in these texts; on the other hand, if we let our imagination run away with us, we might suggest *°ZUR. ŠĀR. GUB. BA* 'decomposition of pyrites, green vitriol' (No. 9 (c)), which is, of course, what we want; and then, by suggesting that salt or *sal ammoniac* had been contained in the lost lines, we should have the ingredients for *aqua regia*. But since *namrûtu ša A. AB. BA* does actually occur in these texts, it is impossible to maintain such a far-reaching suggestion.

16. *a-na I ma-na z[u-k]i-i*
To 1 mana of *zuku*-glass,
17. 16 *kisal [tu-us]-ku-û*
16 kisal of spodos (impure oxide of zinc),
18. 10 *kisal a-ba-[ri] . . . [A]N.NE*
10 kisal of *aba[ru]* (lead, antimony), . . . of saltpetre,
19. $\frac{1}{2}$ *kisal KÛ. [GI] . . . e-la-me-te*
 $\frac{1}{2}$ kisal of go[ld], . . . the discovery
20. *ša(?) katâii(?)^[m] . . . -daiâni*
of the hands(?) of . . . -daiâni.
21. (Possible readings) $\left\{ \begin{array}{ll} \dots & \dots [\text{amount}] [tu-us]-ku-u \text{ (spodos)} \\ \dots & \dots [\text{amount}] [zu]-ku-u \text{ (glass)} \\ \dots & \dots [za]-ku-u \text{ (pure)} \\ \dots & \dots [tu-zak]-ku-u \text{ (which thou shalt purify)} \end{array} \right.$
22. [amount] [A]N.NE (saltpetre)
23. (Possible readings) $\left\{ \begin{array}{ll} [\text{amount}] [nam-ru-tum \text{ ša } A. AB]. BA & \text{(lime of the sea)} \\ [\text{amount}] [°ZUR. ŠĀR. GUB]. BA & \text{(green vitriol)} \end{array} \right.$
24. (Possible readings) $\left\{ \begin{array}{ll} \dots & \dots [da]n-niš \text{ (powerfully)} \\ & [a-da]n-niš \text{ (continually)} \end{array} \right.$
25. [tu(?) -u]s-ku-u spodos (?)
26. [ilu] Ê. A [the god] Ea,
27. *[maš-kan-ti °ba]h-ri-e*
[the composition for co]ral.

Ll. 16-20 are reasonably correct. L. 21 is very difficult: there were originally perhaps eight characters in the line. It should be noted that

although *tuskû* in the nominative elsewhere in these tablets is never written with *u* finally, but *û*, the . . . [*u*]*s-ku-u* of l. 25 suggests that 'spodos' might be supplied here. As for the essential word in l. 23, I naturally give the two suggestions with the greatest reserve. At the same time, while considering the possibility of the knowledge of *aqua regia* in ancient Assyria in the seventh century B.C., it must be admitted that there are some grounds for thinking that the inclusion of the very small quantity of go[ld] to make '[red co]ral' glass, followed by a broken description in an unusual place, presumably to explain a special process, suggests more than a possibility that the Assyrians must have known how to make *aqua regia*.

§ 10. *On the Assyrian geological methods*

The word *IA₄* (*TĀK*), *abnu*, lit. 'stone', is used as a determinative to most forms of minerals (see Jastrow, *PRSM*. 1914, 153: *OTC*. 2), and includes the 'metal' of glass in the process of formation; hailstones (*MANB*. ii, xxxv: also *aban šamê*, *HC*. 25, and black and red stones 'caused to rain' by Adad, Virolleaud, *Adad*, No. xiii, 13, 14); coal (*ana limit kaḫḫadi-šu iṣat abnê¹ tašakan(an)*, *CT*. xxiii, 36, 64); numerous chemicals derived from minerals; and it is also often added to the metals, but it is not clear what the exact significance here is.¹ Undoubtedly the word *abnu* covers a wide field, and there is no need to suppose that booty captured in war which is indicated by *abnu* is necessarily 'precious stones'.

The total number of species of 'stones' occurring as drugs, or, at all events, as aids to the physician, is approximately 120, which leaves only three score or so to complete the total of the Assyrian mineral names determined by *abnu*. In the medical texts of *AM*. they occur less than three quarters of a thousand times, about a seventh of the plant-occurrences (*AH*. v).

Certain minerals are described as 'male' and 'female'; 'male *MUN* (salt)', No. 1 (c), probably sal gem; 'male and female black *aAN.NE* (saltpetre)', No. 1 (e); 'male red *aḡabû* (alum)', p. 34; possibly 'female

¹ The curious use of the det. *abnu* before the metals has no serious effect on their meaning; they retain their metallic value, although perhaps the *abnu* implies a difference in the actual substance; *aKaspu aḥuraṣu a'erû^a* . . . occur, *BBR*. 31, 4, after various stones, but the order has no bearing on their intrinsic value, and depends on their magical effect (cf. also *AM*. 7, 1, ii, 14 where *aKaspu* occurs after *aḡagilmut*, 'thunderbolt'). In *AM*. 102, 20, on the other hand, the metals marked by *abnu* take precedence of a long list: *aKaspu aḥuraṣu aGUG* . . ., with *aAN.BAR* 'iron' separated from them by more than a dozen names of minerals other than metals. In the tablet of amulets, *KAR*. 213 (where the sign *abnu* is absent from every mineral), the metals do not take precedence of other minerals, but are obviously placed in position with a due regard to the composition of the

uḫnû (lapis)', p. 132; 'male and female *muṣû* (misy)', No. 11; 'male and female *ʾšû* (pumice)', No. 99. *EB*. 11th ed., s.v. *Gem*, xi, 561 says that it was the custom of lapidaries to regard the darker stone as masculine and the paler as feminine, but whether this can be applied to the Assyrian lapidaries is doubtful. The Assyrian botanists used the same expressions in botany (*AH*. xix), but to a limited extent, and not necessarily to distinguish male and female plants, the 'male' and 'female' liquidambar, for instance, being so defined probably from the shape of the gum (like the frankincense of Pliny, *NH*. xii, 32, either like testicles or breasts). Neither appear to fit here, particularly the first explanation (through colour), since we have a definite colour 'black' in the case of saltpetre. The use has more probably reference to comparative hardness and softness. This is the explanation given in Pliny's *NH*. xxxvi, 39, for the hard or soft stone within the geodes, the same explanation as actually occurs in cuneiform (see p. 109).

§ 11. *The ZA-group of minerals, and the words for colour*

It is interesting to note a series of minerals beginning with the sign *ZA* (= *abnu* 'stone'), these having the ordinary determinative *tāk* (*ia*₄, *na*₄, *zā*, *ši*). These minerals are *ʾZA. GĪN* (*uḫnû*, lapis, blue), *ʾGUG* (= *ʾZA. GUL*, *sāndu*, cornelian, red), *ʾZA. ṬU* (*NIR*, *ḫulalu*, white lead), *ʾZA. SUḪ* (*ŠUBA*, *šubû*, the base of the words for vitriol). When the 'ZA' is removed, the rest of the sign may give some evidence of the origin of these words: *ʾZA. GĪN* will literally be 'the stone of the mountains', i.e. the distant blue haze (see p. 129): *ʾZA. ṬU* 'the heavy stone', from the weight of the white lead (see p. 137): *ʾZA. SUḪ* 'the stone of wearing out' (*bullû*),¹ from the fibrous appearance of the alum (plumous alum), or crumbling nature of the shale whence the 'white vitriol' came (see p. 93):¹ *ʾZA. GUL* 'the stone of moistening' (the root of *narṭabu*), i.e. the red cinnabar, which becomes the fluid mercury *hydrargyros* after sublimation (see p. 29). (It must be understood that I put forward these suggestions with all reserve.)

Again, in considering this sign *ZA* which has the value *abnu* 'stone', it is well known that the other, more usual word for 'stone' *TĀK*, *abnu*, has the values *ia*₄ and *zā*, but we know of no corresponding *ia*₈ as a value for *ZA*, and yet we might almost assume such a value from **ʾIA*₈. *GĪN* for *uḫnû*. *Ia* seems to be also incorporated in the first syllables of certain words for minerals, i.e. *ianibu* for *ia-anibu* (p. 94), *iartu* for *ia-artu* (p. 165), *iaraḫu* for *ia-araḫu* (p. 97), *iašpu* for *ia-ašpu* (p. 170).

§ 12. *The magical use of colours*

An examination of the various uses of coloured stones, cords, and so forth in Assyrian charms will show a definite system.

¹ *Bullû* 'to destroy' shows its original meaning in the Heb. *bālah* 'to wear out', Svr. *b'li*. *detritus est. in oael. butrefecit.*

First, a brief note on the actual colours is necessary. There are three main different kinds of red: *DIR* (*sāmu*), *GUG* (*sāndu*, the feminine form), and *HUŠ* (*ruššû*). *Sāmu* is used for red ochre on a clay dog (Gadd, *RA.* 1922, 10), blood (e.g. *damušu kima illuri sāmu* 'his blood red as anemone', *TL.* 42 (7)), running to brown, of opium (*AM.* 16, 3, 9), the colour of a donkey (*Camb.* i, 1, Ziemer, *BA.* iii, 477), an ox (*Dar.*, 276, 1), alum (Intro. § 8 (H)), the red of gold (*Nbn.* 489, 4). *GUG*, *sāndu*, if cinnabar (No. 2(j)), would appear to be a brighter colour, as the stone *GUG*, cornelian, also suggests. It can also be used of blood-colour, and perhaps litharge (p. 125). It trends towards a rose-colour in *GUG.ŠILA.SAR* (No. 61, (b)), and other shades will be found on p. 124. *Ruššû*, curiously similar in sound to the Latin *russus*, our russet, represents the same colour: corn (*ašnan*, Pognon, *Wadi Brissa*, A, iv, 48), urine (*AM.* 74, ii, 12: 94, 2, i, 2: 95, 2, iii, 5), and gold (*hurašu* frequently, and *šariru*, No. 5 (b)) are defined by it, and *rašāšu*, the cognate verb, is applied to glass glowing red, before it becomes yellow (*harāšu*, Intro. § 7).

Blue is *ZA(IA₈?)*. *GĪN*, *uknû*, *βάκινθος*, *κύανος*, perhaps the colour of the distant mountains (see § 11), with various shades given in No. 15 (a). *Šamaïtu* 'heavenly blue' is applied only to blue vitriol (No. 9 (d) (5)).

Green and yellow have always been a difficulty, as they are defined by the same word *arķu* (*SIG₇*): the Heb. *yāraḳ* describes the green grass or the pallor of the face. The Assyrian root defines grass (*urķitu*), the green clay 'body' made with verdigris (Appendix II), the pallor of the face in terror (iv *R.* 50, b, 44), the yellowish-green of the spurge (*GĪ. RIN arķu* 'yellow-green flower,' *AH.* 3), becoming yellower in jaundice (*amurrikanu*) and trending to a brighter yellow with the double *SIG₇*. *SIG₇* in the words for orpiment (No. 4 (g), (h), (i)). Perhaps the *NIM. SIG₇*. *SIG₇* = *šasuru* is the yellow wasp, but the more common wasp in Mesopotamia is the large, handsome insect with its red and yellow bars (*JRAS.* 1934, 774). The brightest yellow is represented by *hurašu* 'gold', the root *harāšu* meaning 'to glow yellow' after *rašāšu*, 'glowing red' in the Glass-texts (Intro. § 7).

As for white and black, they are represented by signs for 'day' and 'night'. *Piṣû* 'white' includes *pīlu* limestone (No. 21 (a)), silver (No. 6), and even gold (*hurašu piṣû*, ii. *R.* 26, e-f, 57), and the verb is used for the white heat of glass (Intro. § 7). *Šalmu*, black, includes cummin seed (*Nigella*, *AH.* 8), anemones (*AH.* 9), the castor oil plant (*AH.* 17), and storm-clouds (*GE.* xi, 93).

The parallelism of *GUG* (= *ZA.GUL*) with *DIR*, both meaning 'red', suggests that we have two classes of colour-signs, the one, (perhaps earlier) *PAR*, *GĪG*, *SIG₇*, *DIR* (white, black, yellow-green, red), and the other, the colour signs beginning with *ZA* (§ 11). 'Blue' is

always represented by *aZA.GĪN*, suggesting that it was a later borrowing; *aZA.ṬU* and *aZA.SUH* are never used to describe colours.

Now, in discussing the system on which the colours were used in magic, it must be noted that, just as in later times the alchemists associated deities with chemical substances, so did the Assyrians. It was a common principle in antiquity (see Cook, *Zeus*, 626). In *PBS.* x, No. 4, 337, Langdon gives a list of these: silver is *iluGAL* (Marduk, Aa, &c., *D.* 343, 12), gold *iluEN.ME.ŠAR.RA*, copper Ea, and so on. But more indicative still are the passages which show the powers of light and darkness as represented by the white *gašsu* gypsum, and the black bitumen (p. 42). It is this last which gives us some evidence on which to base a system of colour-magic, which should be very simple to discover. This antithesis of white and black is shown in *Shurpu*, v-vi, 144 ff. where a woman is directed to spin a double thread of white and black to bind the head, hand, and foot of the man under a tabu, which is then removed as symbolical of removing the tabu, and thrown away in the desert.¹ But the magic is still clearer in the use of red wool for a woman with menorrhagia; red wool is to be spun into a thread with a sinew of a cow that has been 'covered' (to make certain that it is full grown, and so in sympathy with the age of the woman), iron and *adbaru*-stone (either pumice, or the calcined alkali as styptic), twisted (*pitil*), and put into her 'middle' (pubes) (*KAR.* 194, i, 31). Another for the same (*ib.* 22) prescribes that the male **andropogon*, red wool, and the sinew of a 'covered' cow shall be spun by a 'separated' woman (during her period), tied with fourteen knots, with *adbaru*-stone knotted into the middle, rolled in red wool, the whole knot to be placed beneath her girdle (band), and fastened on her 'middle'. In the case of a (bloodshot) eye, red wool is to be put on the sick eye, white on the healthy eye (*AM.* 10, i, iii, 15-16). The red obviously represents the blood, just as the black and white the principles of evil and good (see p. 160).

Similarly the blue wool represents the blue of a 'swollen muscle', a twisted thread of blue and white containing three garnet(?) beads being used to remove the (discoloured) swelling (p. 164).

The stones used as beads in these magical charms all have a related significance. Just as the magnetic iron ore and iron filings are used symbolically in love-charms (p. 86), so do we find a group of three

¹ Although this principle of magic is so well known, and has been the subject of so much comparison with the customs of other peoples, the following, from Tournefort, *Voyages*, 1741, iii, 247, is worth quoting from his account of baptism among the Armenians: '... there are still many Priests who do it thro mere ignorance. While the Curate recites certain Prayers of his Ritual, he makes a small Cord or String, one half of white Cotton, the other of red Silk, the Shreds whereof he has himself twisted separately. After having put it on the Neck of the Infant, he makes the Holy Unction on the Forehead, the Chin, Stomach, Armpits, Hands and Feet, by making the Sign of the Cross on each Part.'

minerals—'hate-stone', *^aSAG.KAL*, and native arsenic' (p. 188)—that 'a favourable finger' may be pointed after the wearer. What the 'hate-stone' is is doubtful. The stones used for obtaining the favour of Adad, the sky-god, are naturally of green, blue, and crystal (p. 183). And so on; the list might be multiplied indefinitely.

§ 13. *Beads* (*^aIGI* 'eye-stone', and *^aNUNUZ* 'egg-stone')

Apart from certain special 'eye' stones (see Nos. 32, 33), there is a common Assyrian use of *^aIGI* (*énu*), lit. 'eye-stone', hitherto customarily regarded as a special kind of stone, particularly agate, either cut into the shape of an eye or found naturally in this form (cf. *Bab.-Ass.*, i, 351). 'Eyes' of this kind, it is true, are fairly common: e.g. a pair of onyx 'eyes', inscribed with a dedication to Ningal by Abi-ešuh (c. 2000 B.C.), in three colours, dark and light brown, and white, thus representing the colours of the modern Arab eye.¹ (Langdon, *RA.* 1923, 9). Langdon (*ib.*) instances others; one in onyx with an inscription of Nebuchadnezzar (Ménant, *Glypt. Or.* ii, 142 ff.; note particularly 147): some plano-convex agate eyes, Kassite period (Hilprecht, *OBI.* No. 29 ff.). Price (*JAOS.* 1923, 52) refers to an inscribed eye of banded agate dedicated to Nabû by Nebuchadnezzar.

But there is nothing to show that these 'eyes' are represented by the Assyrian *^aIGI*. A lapidary's list (Kassite period, Legrain, *UMBS.* xiii, No. 80) speaks of (17) 5 *NUNUZ-in* *^aPAR. AŠ rabûti^{pl}* (18) 7 *IGI* *^aPAR. AŠ adi 1 lulidanitum iħzu* (19) 6 *IGI* *^aPAR. AŠ šihruti^{pl} la iħzu* (20) 4 *IGI* *^aširgarri iħzu ħuraši* '5 egg-shaped (beads) of alabaster, large: 7 beads of alabaster besides 1 *lulidanitum* (see p. 76) set: 6 beads of alabaster, small, not set: 4 beads of serpentine set in gold.' Similarly we find in *TA.* 13, 3, *énâte^{pl}* *^aPAR. AŠ* "'eyes" of alabaster': *UMBS.* ii, No. 105, 3 (cf. 11), 1 *^aPAR. AŠ. AŠ 1 IGI.PAR. AŠ* '1 chalcedony, 1 "eye" of alabaster'. It will be noticed that the eyes here are of white and of green (if *^aIGI. širgarri* is here a bead and not a particular stone, see p. 156) the latter being hardly a correct colour for eyes. Knudtzon is nearer the meaning with 'gems' (*TA. ib.*). *AM.* 17, 3, 8 is equally clear: '4 *énâte^{IIpl}* šá *^aPA (?)* . . . 'four eye-stones of *PA (?)*-stone . . . '²

Equally important for the meaning is the passage in the Descent of Ishtar (K. 162, K. 7600, *CT.* xvi, 47, 48: Witzel, *Orientalia*, 1923, 84): 'She heard the sound of her brother: then threw Bêlîli her ornaments on [the ground]: with her eye-stones [*^aénâte^{pl}*] [her] chamber was full.'

¹ Cf. King, *Curious Lore*, opp. p. 148, for numerous eye-agates from Arabia. The Assyrian stones may be the *Beli oculi* of Pliny (*NH.* xxxvii, 55), of a whitish hue surrounding a black pupil, which shines amid a lustre like gold, and is consecrated to Belus.

² The meaning of ii *R.* 51, 18 *a-b* (the text which gives the provenance of minerals) is not clear: *šadûTIL.LA.*, | *šad e-na-te* | *šadûSA.AG.GIŠ.*, | *šad e-*

Equally important is iv. R. 55 [62], i: e.g. (4) *ina kišadišu tašakan(an)* 7 *‘ênâte^{pl}* 7 *paré¹* *ina šipati šalimti*, &c. ‘On his neck thou shalt put 7 “eye-stones” 7 *paré* on a black thread’: (10) *lappi ša birit ‘ênâte^{pl}* *paré ina libbi talpāp* ‘a binding (a “serving”?) for between the “eye stones” (and) the *paré* therein thou shalt overlay (serve, bind)’: and from (13) onwards, 14 *hušab* ^aA. ZAL. *LÁ ina riksi pišī tukašar-ma* (14) *ina kišadišu tašakan(an) ‘ênâte^{pl}* [sic] *paré kališina ina šipati šalimti tašakak* ‘14 shoots of hemp on a white cord thou shalt bind and put (it) on his neck: all the “eyes” (and) the *paré* thou shalt thread on black thread’.

From the *IGI*-bead, doubtless spherical, we can go on to what must be the ovoid bead, *‘NUNUZ*, which is contrasted with *IGI* in the text from *UMBS.* xiii given above. This is equated with *erimmatum* (‘A’ 13, ‘G’ 16, properly ‘case-tablet’, but also the geodes stone containing another (see p. 107)), the comparison being doubtless with the egg inside the fowl. The various colours are given in *CT.* vi, 11, 24, a ff.: *‘NUNUZ.PAR* (white) (also *UMBS.* xii, No. 14, 12), *‘NUNUZ.GÍG* (black) (also *UMBS. l.c.* 13), *‘NUNUZ.DIR* (red), *‘NUNUZ.SIG₇*, (?) *A* (green?), *‘NUNUZ.SIG₇.SIG₇*, (yellow). Other forms are: *‘NUNUZ.GÚ nru* (‘A’ 14, ‘G’ 17) ‘yoke’, ‘collar’ (?), neck-beads; *‘NUNUZ.DU₁₃.DU₁₃*, ‘very small egg-shaped beads’ = *šiprétu* (‘A’ 15, ‘G’ 20), possibly Heb. *šawwārôn* ‘necklace’, which are measured by weight (12 mana, *RTC.* No. 304, iii. 4) (cf. *e-rib* (?) *-di-e-tu*, ‘A’ 16); *‘NUNUZ.TAB.BA* (‘twin(?)’-egg-shaped beads’); *‘NUNUZ.III.TAB.BA* = *šipréti*, ‘G’ 19. (For bead-shapes see Beck’s admirable article in *Arch.* 1927, 1 ff. I remember seeing in a Mesopotamian bazaar an obviously ancient white stone of the shape and size of an egg.)

§ 14. *TAG.GAZ* (*TÁG.GAZ*, *TÀG.GAZ*)

takkassi, takkasu, cut stone

The reading would appear to be *TAG* as the first sign (see below). Haupt (*OLZ.* 1913, 493) suggests *abnu hep̄tu* as the equivalent for *TÁK.KĀS*, and he translates it ‘zerriebene Steine’. Boson (*It.* 400) makes it ‘pietre macinate o metalli polverizzati’. That it represents a condition, not an actual mineral, is clear from the following:

(1) Senn. (*Luck.* 34, iii, 41) takes tribute from Hezekiah of 30 talents of gold, 800 talents of silver, *nišik̄ti guh̄li ták-kās-si* ^aA. *GUG.ME rabūti^{pl}* ‘precious (stones(?)), koh̄l, great *takkassi* of *AN.GUG.ME*-stone’ (p. 127). (2 *-tim*?) *ták-kās-si* occurs *ADD.* 937, ii, 8).

(2) *‘TAG.GAZ dušī* = *tak-ka-su* ‘*TAG.GAZ* of crystal = *tak-kasu*’ (Scheil, *RA.* 1918, 116, 45). The same (*TÁG.GAZ dušī*) heads a list of nine minerals for ‘a position in the palace’ (*KAR.* 213, iv, 9), the other (*šūgarru*, *PAR. AŠ*, *GUG*, *GUG.KA*, *KISIM.ŠAR.A*, *ašpū*, *AŠ.GĪ.GĪ*, and *marḥallum*) not being marked with *TÁG.GAZ*, and

¹ *Pa-ri-e.*

yet some of them are certainly connected with this word in other passages (see further). The same peculiarity of insertion of *takkas* before one particular stone occurs in *AM.* 2, i, 8 + *CT.* xxiii, 37, 9, *Šumma amelu kaḫkad-su ittenibaššum* . . . [^aMUŠ]. *GIR* ^atāk-kàs ^aGUG. *marḥaši* ^aKA. ^aĜĜ ^aḫulalu ^aAN. *ZA.* [KAN?] . . . [^a]KISIM. *PA.Ē* 8 *abnē^{pl}* *annuti ina nabaši šipati piṣi teṣimmi* . . . [ina] *SAK.KI^{II}-šu* *tarkas-ma ibaluṣ* 'if a man's head is offensive (?) . . . serpentine, *takkas* (of) aventurine, black ochre, white lead, ^aAN. *ZA.* [KAN?] . . . *KISIM. PA.Ē*-stone in red and white wool thou shalt spin . . . , bind [on] his temples and he shall recover'. In 'Y' 12 *TĀG. GAZ* *ši* . . . followed by ^asāmtu *ši* . . . is difficult.

(3) *Uḫnū*, lapis: ^aTAG. *GAZ* *uḫnī* = [^aḫ]a-pa-ša [*uḫnī*], Scheil, *l.c.*, 117, 91. It was brought from Media by Esarh. (*tāk-kàs* ^auḫnī, *PE.* iv, 38).

(4) On K. 23 (*ADD.* 993, re-exd.) are mentioned (4) *ī tāk-kàs si-e me-šil-šu a-na ī abni me-šil-šu i-su-ḥar* '1 *takkas* of whetstone, its half for one stone, its (other) half is returned'; (7) *ī tāk-kàs aš-pu-u a-na 3 abnē^{pl}* '1 *takkas* of jasper for three stones'; (10) *ī tāk-kàs aba-rum-mu a-na ī abni* '1 *takkas* of *abarummu* for 1 stone'; (17, cf. ii, 11) *ī tāk-kàs SAK.KI(?) ar(?)-ḫi ī ultu libbi na-ši [ri-iḫ(?)]-tū i-su-ḥar* '1 *takkas* *SAK.KI(?) arḫi(?)*, 1 taken therefrom, the rest are returned'; (ii, 2) *ī tāk-kàs GUG.SILA a-na ī* '1 *takkas* of rose-red quartz for one'; (ii, 8) *ī tāk-kàs ^aUR a-na ī* '1 *takkas* *UR*-stone for one'; (ii, 11) *ī tāk-kàs su-u ī ultu libbi na-ši ri-iḫ-tū is-su-ḥar (?)* '1 *takkas* of whetstone, one taken therefrom, the rest are returned (?)'; (ii, 16) *ī tāk-kàs ŠĀR. [GUB(?). BA(?) 2 ultu libbi na-ši-u ri-iḫ-tū is-su-ḥar* '1 *takkas* of pyrites (vitriol-stained(?)) 2 taken therefrom, the rest returned'. This would appear to be the list of a jeweller who has received various cut stones, some of which he returns to the lapidary who offered them (?).

(5) A contract of Nabopolassar's time mentions ^atāk-kàs ^aPAR. *AŠ* (alabaster, Scheil, *RA.* 1926, 46). A letter (*ABL.* 847, r. 2) is precise: . . . *-pi 3 ubani ruṣša ša tāk-kàs ša ^aIGI. ZAG. GA ana ^mA-dan(?) -iḫ-ili ^{am}NI. GAB a-ti-din* 'I have given . . . 3 fingers its breadth, a *takkas* of *IGI. ZAG. GA*-stone to *Adaniḫ(?) -ili*, the door-keeper'.

It would seem that *takkasu* is very near our 'cut stone'. At the same time it includes heavy slabs(?): e.g. *ī biltu 6 mana tāk-kàs ^a. . . la basili*, which is between sixty and seventy pounds (*ADD.* 812, r. 1).

§ 15. The methods of pounding and crushing stones, and glass

There were two principal kinds of mills in antiquity which the Assyrians would have used: (a) hand-mills for different substances, and (b) mills turned by animals. The Romans made them of volcanic trachyte or porous lava (W. Smith, *Dict. of Antiquities*, s.v. *Mola*), and in the Hauran the upper millstone is still made of the latter material.

the lower being compact sandstone (Thomson, *The Land and the Book*, 528); Burckhardt (*Syria* 57, quoted Smith, *DB*. s.v. 'Mill') speaks of a black tufa brought in blocks from the Lejah and fashioned into millstones at Ezra in the Hauran. These latter are doubtless the ^a*HAR.AD.BAR*, *el[r]û adbari* 'mill of lava (basalt)' (No. 21 (e)). This popularity goes back to the time of Xenophon (*Exp.* 1, v, 5), the people of Pylae (between Alexandretta and Aleppo) being said to make a living by selling millstones. *IB.* (632) speaks of a *hajar ar-rahâ* 'millstone' called *al-kôf*, which was said to come from the east of Aleppo. The modern millstones in Basrah were, so far as I could see, of granite, both upper and lower being 1 ft. 6 in. across and 1½ in. thick. The upper was revolved by means of a wooden handle on a metal pin set in the lower, which projects through a hole fitted with an iron eye in the upper. The Assyrian handmill is ^a*HAR.ŠU* (= *erû kâti* 'hand-mill', *erû habîši* 'baker's mill', and *erû...du-ri*, unknown, 'C' 15, 6; 'D' 5; 'F' 15-17). This is expanded to ^a*HAR.ZID.GU* 'mill for *GU*-flour,'¹ as distinct from ^a*HAR.ZID.ŠE* 'corn flour mill' (on the same tablet, alongside each other, 1st Dyn. of Babylon, *CT.* viii, 34, Bu. 91-5-9, 2504, and cf. for the same two, Ranke, *PBE.* vi, 1, 26, of the date of Ammiditana).

The larger mill would appear to be ^a*HAR.zi-bu-um* (v. *zi-e-bi*) = *erû zîbi* = *erû ha-ši-lu*(?) ('A' 37; 'C' 17), the last word being read *HA.ŠI.HAR* by Matoush, but I am doubtful about such a word, and suggest emending the last character, *hašâlu* being one of the words in the Glass-texts for crushing. *Zibu* is unknown. I have seen a large roller revolving on a platform at Nebi Yunus, turned by a beast, to crush grain. ^a*HAR.DUK.ĶA.BUR*, *erû paĥari* ('potter's mill') must be the potter's wheel, usually made of a heavy stone (see *ĴRAS.* 1923, pl. iii, 14).

Other methods of crushing stones are by means of pestle and mortar. ^a*NA* appears to represent the mortar in such groups as ^a*NA.GŪ.BI.NA* (*ŠU-ku, duĥtu*), a mortar for braying some form of *GŪ* (beans, or similar vegetable), and ^a*NA.ZAG.ĤI.LI.ŠAR* (*uršu, mazuktu*) for crushing *sihlê* (which I take to be *lolium temulentum*, but with considerable reserve). ^a*NA.ZA.GÎN.NA* is for crushing ultramarine (for these see 'C' 30-2, 'D' 9-11). Mortars are used at the present day in the East for crushing corn (Thomson, *The Land and the Book*, 94), (those used in Basrah have a large wooden pestle, as much as a woman can use): they were also used for manna (*Num.* xi, 8), and spices (Smith, *DB.* ii, 423).² But ^a*NA* may possibly represent the pestle also, it being the

¹ = *GŪ*, not a corn, but such seeds as fenugreek, lathyrus. Of the *erittu* (*CT.* xix, 44, K. 4138, r. 12) (a feminine form of *erû* 'mill') there were three kinds, one for corn, one for sesame, and the other for dates. It is still usual to grind the date-stone for camel-fodder in Egypt (Hasselquist, *Travels in the Levant*, 261). The 'upper millstone' is ^a*narkabu* (*CT.* iv, 30, 4, a).

² Another word is ...*GAZ.ZID.GAZ* = *madakku*, with ...*GAZ.ZID.GAZ* =

abnu ša aškapi 'mallet of the leather dresser'. Properly, however, the pestle was *amittu* or ^aNA.ŠU, as in ^aNA.ŠU.ZAG.ĤI.LI.ŠAR (= *elit urši, elit mazukti*, 'C' 32, 'D' 12).

In MT. salt is brayed in NA.ZAG.ĤI.LI, a lolium-mortar (AM. 14, 8, 7), as well as in an *urši* (AM. 24, 3, 14). '10 shekels of *sihlē* (lolium) *ša KA* (^a)*urši ša šilikka* (?) NU RU (*tābtu*) *tābātu* NU *šulput* 'which the mouth of the mortar has not released for the baking (?) (Syr. *š'laḳ*) (nor) (salt, nor) vinegar spoilt' (KAR. 202, 15: CT. xxiii, 23, 10). ^aḤašanu (thyme?) and ^kkukru (fir-turpentine) are to be pounded with a pestle (*ina amitti tudakkak*, AM. 41, 1, iv, 35).

§ 16. On the staining of stones

That the ancients were well aware of the susceptibility of certain stones to staining with artificial colouring is well known. Pliny says that in Arabia cochlides, if cooked seven days and seven nights in honey, will become striped or spotted (NH. xxxvii, 74); that the Indians imitate precious stones, particularly beryls, by colouring crystal (NH. xxxvii, 20), and that an artificial cyanos was made (NH. xxxvii, 38). The Periplus (ed. Schoff, 193) mentions a curious treatment in obtaining agate and carnelian (burning). The method of staining stones is fully described in SEC. 90.

E. Streeter (*Precious Stones*, 5th ed., 38) describes the more modern industry of working in agate in Oberstein and Idar. Onyx, for instance, is twice washed, dried, laid in honey and water, or sugar and water, or in oil, and placed in an oven, care being taken that the stone is always covered with the liquid and that it does not boil, for from fourteen to twenty-one days. The stone is then washed, and placed in sulphuric acid in a dish, which is covered and placed in hot ashes, and in a short time the stone will be dried by means of the carbon in its pores. 'Brazilian Carnelian' (*ib.* 39) (of a red colour) is made by steeping the stone in green copperas or ferrous sulphate, and then exposing it to heat: while blue agates can be made from blue vitriol and ammonia. 'In fact', he says, 'the chemical resources of the German Agate-worker now enable him to colour a porous stone to almost any desired tint' (p. 39). Michael Weinstein (*Precious and Semi-precious Stones*, 24) says that in general all porous stones may be treated successfully. Chalcedony is one of the cheap materials; heating alone accentuates the colour of many agates, he says, while the bright red carnelians are the result of applied artificial heat, the stones sometimes being impregnated with a solution of iron vitriol before heating. Quartz cat's-eye (according to the same authority, p. 25) is sometimes seen with unnatural vivid greenish and bluish effects, while many types of quartz as well as topaz and zircons are subject to alteration by heating.

quality are known as *hyacinth*, when of a reddish-brown colour these stones may be completely decolourized by heat, and then they are sold as diamonds (*WM*. 131).

Seeing that the dyeing of stones was well known to Pliny as being a trade known to the Arabians and Indians, we should be entitled to suppose that the Babylonians must have borrowed it or discovered it for themselves, even if Beck had not discovered instances:

'A certain number of small shells [from Nineveh] are blackened, I believe artificially and by means of iron. How this was done is not yet known, but the method has been carried on from an extremely early date, having been applied to a large number of ostrich shell beads found in Kenya by Mr. L. S. B. Leakey, who believes that they date to the Aurignacian period' (Beck, *Antiquity*, 1931, 432). Can these 'shells' be Pliny's cochlides?

Now in Assyrian the phrases *^aŠIM.SIG₇* and *^aSIG₇.SIG₇* occur as equivalent to *šurruṣu ša abn[i]* 'dyeing of a stone' (ii. R. 34, 61, 62). This will explain the apparent difficulty of the seal of *^aZA.SUH₇*, which may thus be a seal dyed with *^aZA.SUH₇*, iron vitriol (p. 93). Noticeable, too, is K. 996 (*ABL*. No. 570) a letter, of which the writer's name is lost (he was probably a physician) discussing first the king's son who says that 'all his limbs are well', and then recommending a certain procedure with fumigation (or incense) and oil of **opopanax* and oil of **liquidambar*. He then goes on to say 'Now . . . the beryl-stone . . . I have caused (or, will cause) to boil: in . . . of the beryl . . .'. Are we to see in this any procedure for dyeing a stone, such as has been described above?

§ 17. *The channels through which Babylonian knowledge reached the West*

Mesopotamia, situated as it is in a landlocked kingdom without the advantages of the comparatively safe sea-travel between Mediterranean ports, had not the opportunities of interchange of amenities which Alexandria, or even Constantinople, had subsequently. Moreover, after the Fall of Nineveh in 612 B.C., cuneiform seems to have disappeared entirely from the northern half of the Mesopotamian kingdom, and Babylon became again the centre of culture, thus making the sources of cuneiform learning still more remote from Europe. Nevertheless many words in Greek and Latin show a parentage which must be referred to Babylonian cuneiform, especially in the fourth century, which was, of course, due to the increase of intercommunication between the West and the Near East. Merchants were doubtless the first agents to introduce Babylonian words into Greek, and with this comes the difficult problem of the apparent similarity of χρυσός with *hurušu* 'gold', χιτών, *kitinnu* (from *kitu* 'flax'), κρόκος the Babylonian *kurkanu*, curcuma,

'axe'.¹ Doubtless one wide channel of interchange lay through the Greek colonies round the Mediterranean; it is about the time of their heyday that we hear of Anaximander of Miletus (610-547), introducing the style or gnomon from Babylon.² Thales of Miletus, too, (b. c. 636) is said to have visited Egypt, representing that type of Greek traveller, whereof Herodotus (b. 484) is the most distinguished. In this Greek colonial period begins the contact of the Assyrian armies with Europe, the *rencontre* of Sargon (722-705) with Yamani ('the Ionian') and his congeners, Sennacherib (705-681) in his campaign into Cilicia where he would meet with the Greeks, the foray of Esarhaddon (681-668) into Cyprus, and Ashurbanipal's occupation of Egypt and particularly his meeting with Gyges of Lydia towards the middle of the seventh century. No doubt, also, after Assyria had ceased to exist, the Captivity played an ultimate part in disseminating Babylonian learning, even if indirectly, and then followed the Persian invasion of Europe at the beginning of the fifth century, the retreat of the Ten Thousand at the end of the fifth century, Alexander's campaigns in the fourth, and finally the renaissance of Babylonia under the Seleucids. All played their part in linking up East and West the more closely with every century.

Harking back for the moment to the end of the Assyrian kingdom, we can trace therefrom the gradual decay and final extinction of the cuneiform character as a means of writing just before the Christian Era.

As has already been said, it was the temples in which the libraries of cuneiform tablets were stored. Ashurbanipal not only preserved a library in his palace, but also added to the little collection in the Temple of Nabû at Nineveh. With the downfall of Assyria these books in the palaces and temples were buried in the ruins, and thereafter were frequently dug up and thrown carelessly about by the later occupants of the

¹ Of the numerous words taken over from Babylonian into Greek or Latin the following may be mentioned (without determinatives) (cf. also Zimmern's *Akkadische Fremdwörter*): (Plant-names), *armamu*, apricot, ἀρμενιακόν: *AŠ*, *asa foetida*: *azupirānu*, safranum (med. Lat.): *burašu*, pine, βράθυ: *HUL.LI.LI.GA* (κολοκύνθη?): *kudimeru*, κάρδαμον: *kamutu*, κύμων: *kanaktu* (πανάκης?): *kurkanû*, curcuma: *karšu*, κερασός: *lardu*, λάρδος: *lasirbitu*, laserpitium: *murru*, μύρρα: *musuk-kamu*, σικκάμνος: *NAM.TAR.GIRA*, μανδραγόρας: *PA.PA*, poppy (papaver?): *sanapu*, σίναπι: *šarbatu*, strobis (στύραξ?): *šamaššammu*, σήσαμον: *šurmenu*, τέρμινθος: *TAR.MUŠ*, θέρμος. (Mineral-names) *AŠ.MUR*, σμύρις: *algamišu*, ἀμέθυστος: *burallu*, βήρυλλος: *barraktu*, σμάραγδος: *gaššu*, γήψος: *ešmarû*, émail (see *kibaltu*, below): (*i*)*aš(s)pû*, ἱσπίς: *immanakku* (ἀμμοκονία?): *kibaltu* (cobalt (?)), any intermediate stages being lost, like *ešmarû*: *KA.GI.NA.DIB.BA* (μαγνήτης (?)): *aban kašari*, pumice, κίσηρις: *mušû*, μίον: *nîritu*, νίτρον: *pîlu* or *parātu*, πῶρος: *sāndu*, red (stone), σάνδωξ: *sāndu marhašitu*, sandrisitae: *uḫnû*, κύανος, ὑάκινθος. Most of the Greek words are to be found in authors of the fourth century B.C., and some go back earlier.

² The clepsydra, too, was another importation from Babylon first mentioned in Greek in the fifth century. For the *LU.LU* and the evidence for it as the

mounds in their search for building material. Hereafter the centre of learning passed to Babylonia for a brief three-quarters of a century, and then with the Persian domination of Babylon in 539 begins the gradual decay of Babylonian as a spoken language. Cuneiform contract tablets, still plentiful in the reign of Darius, begin to decrease rapidly by the middle of the Fifth Century, and the writing of letters in cuneiform, so common hitherto, was given up about the same time. This last is a definite indication of the passing of the old speech of Babylonia, for naturally no scribe will write a letter if there is a probability that the recipient will not be able to find someone who can read it for him. It was only the priests who retained a knowledge of Babylonian cuneiform; even Persian cuneiform never established a proper foothold. The younger generation had now no need to learn the laborious syllabary and it is easy to see the advantages of the simple alphabet of Aramaic, which even in the eighth century had been coming into the country, as is shown by the impressions on the sides of the cuneiform contracts in the north for the benefit of those who knew it better than cuneiform.

Under Seleucus Nicator (312-280 B.C.) there was an academic revival. The capital was transferred from the banks of the Euphrates at Babylon (where even by this time the ancient mounds must have dominated the levels) to another site to be called Seleucia after the founder. Here over a widespread level area were to live half a million inhabitants on the banks of the Tigris, with little knowledge of cuneiform, if we may infer anything from the paucity of tablets.¹ Yet the priests of several temples—Babylon, Sippar, Borsippa, Erech—according to Pliny (*NH.* vi, 120-3) and Strabo (*xvi*) still retained their schools, and these conducted business in cuneiform. But not only were Greeks to be found in the markets—indeed, it had now become a common custom for a man to have both a Greek and a Babylonian name (e.g. 'Aristeas whose other name is Ardi-Bêlti', in Greek on a jar from Erech, *BRP.* iv, 54)—but actually the stater had become current, and several documents in cuneiform record payments in silver staters (*istattiranu*). Indeed, in 276 it is recorded on an historical cuneiform tablet that 'copper coins' of Greece were current in the bazaars of Babylon (S. Smith, *Bab. Hist. Texts*, 156). Seleucia could even send its son Diogenes to Athens as head of the Stoic school there.

From Erech, doubtless from the great temple of E. Anna, have come numerous tablets of the VIth-Vth centuries (Dougherty, *Archives*), dealing with receipts of wool, hides, animals, cattle, bricks, iron, barley, dates, sesame, honey, salt, even the oil for services at festivals. The temple-deeds go down far into the Seleucid period (*BRP.: Vorderas. Schriftl.*, xv), and a seal inscribed ΑΛΙΚΗ ΟΡΧΩΝ shows that there was even a salt-works there (*BRP.* iv, 53). The worship of Anu

¹ See Waterman. *Excavations at Tel Umar*, where this is obvious.

certainly was still going on in 190 B.C. at Erech; the temple-scribes were still copying the ancient texts, as a fair number of literary tablets (omens, rituals, and magical texts), which cover a period of perhaps half a century about this date, shows (*TU.*). In Borsippa, Antiochus Soter (280-260 B.C.) with a brief reminiscent conservatism, doubtless to placate the priests of Nabû, devoted a little cuneiform cylinder to that shrine, recording his pious restorations (v *R.* 66).

But Seleucia could hardly rival her sister Alexandria, which by the beginning of the third century was to become the centre of Greek learning, doubtless attracting numerous Oriental doctors. It was the Alexandrian alchemists of the Christian Era who were to hand on the lamp of chemical learning, although little is known between their period and that of the Arabs some 600 years later. Alexandria was in turn early to yield to Rome and Pergamos, the latter city producing Galen (A.D. 129). We can show little direct evidence that Babylonian science was adopted by the Greeks at this period, except perhaps in the field of astronomy, which is the one study in cuneiform throughout this latter time which shows any advance. Hipparchus (160-127 B.C.) made use of the older Greek and the Babylonian records, and Dampier (*HS.* 49) thinks that it is certain that he must have known the work of a celebrated Babylonian astronomer called Kidenas by Posidonios (the latter born at Apamea in Syria c. 135 B.C.). It is this latter writer who has preserved for us the names of this and two other learned men of Babylon, Naburianos and Sudines; in the name Kidenas Kügler has recognized the Babylonian Kidinnu, and in Naburianos Weissbach has seen Nabû-rimanni on a late astronomical text from Erech (see Schnabel, *Berosus*).

The latest tablets written in cuneiform, as far as we know, are dated in the last decade of the first century B.C.¹

Except, therefore, that we can say that the Babylonian temples kept alive the old capacity for writing cuneiform, and for copying old rituals, and that the Babylonian astronomical guild was the one branch which was not moribund even in the first century B.C., we cannot trace any scientific activity in cuneiform after the Fall of Nineveh. The gap in the records of chemical discovery between the Royal Glass-texts of the seventh century B.C., and Leyden and Stockholm alchemical papyri of the third century A.D.² is a wide one, and must be filled by inference.

¹ See Schnabel, *ZA.* 1925, 66-70; Schaumberger, *Misc. Orientalia*, 1935, 279.

² Brunet and Mieli, *Hist. des sciences: Antiquité*, 995.

1. THE SALTS

- 1 (a) *Ṭābtu*, *MUN* (*aban dāme*, *aMUD*), simple salt, sodium chloride ('the stone of blood').
- 1 (b) *Ṭabat* (*MUN*) *EME.ŠAL.LIM*, probably sodium chloride with magnesia, &c.
- 1 (c) *Ṭābat šadī*, *MUN.KÙ.GA*, probably *sal gemma*.
- 1 (d) *Ṭābat amāni*, probably the red *sal gemma*, or the *Andarānt* of India.
- 1 (e) *Mil'u*, *AN.NE*, nitrate of potash.
- 1 (f) *Ṭabat A.ŠAL.LIM*, a form of saltpetre(?).
- 1 (g) *Epir asurri*, impure nitrate of potash and carbonate of soda.
- 1 (h) *Nitiru*, *nitru*, carbonate of soda.
- 1 (i) *Samānu ša igari*, nitrate of potash and nitrate of ammonia.
- 1 (j) *Iṭru*, *iṭrānu*, properly sal ammoniac, but generally for salt efflorescence.
- 1 (k) *Ṭābat būri*(?), *MUN.būri*(?), carbonate of soda(?).
- 1 (l) *Ṭābtu barikatu*, *MUN.IN.TU.RA*, borax(?).
- 1 (m) *MUN.KÙ.PAD.DA*, bread borax(?).
- 1 (n) *Ṭābat mānu*, *MUN.e'-(?)*-ri, unknown.
- 1 (o) *Uḫulu*, *ELTEG*, vegetable alkali.
- 1 (p) *aṬābti šikkati*, *aDÜ.SUB.BA*, alum (see No. 58).

1 (a) *Ṭābtu*, *MUN*, simple salt, sodium chloride (*aban dāme*, *aMUD*, 'the stone of blood', as a possible synonym, 'C' 11).¹

'C' 11, 'F' 6, 12, 'X' 3. Long identified as salt. Tablet VIII, *Maḫlū* (King, *CT.* xxix, 10) invokes it: *atti ṭābtu ša ina ašri elli ibbanū* 'O thou salt, created in a pure place'. It preserves meat: 'put the meat which hath been brought thee into salt' (*ṭābtu*) (*LBL.* No. 221): 'suet of the kidney of a male sheep which has not² been put into salt (*ṭābtu*)' (*AM.* 45, 5, 3, cf. 2, 1, 13): of fish, 'in salt thou shalt preserve until sunrise' (*AM.* 15, 6, 13): cf. also *AM.* 57, 10, 3, and perhaps thus in the account of fish and salt (together) sent to Agade (*ITT.* No. 1086). One of a pig's litter (a 'monster') is preserved in salt (*MANB.* ii, No. 227, r. 2): also the corpse of Nabû-bêl-šumâte (*Asb.* vii, 39-40). *Asb.* strews the fields of his enemy with salt and *saḫlē* (tares) (*ib.* vi, 79). Rubbed into the flesh of an *AL.DI.URU.GA*-bird, which is then to be dried and given to drink to a man to cure impotence³ (*Ebeling, MAOG.* i, 49, 24). Similarly *ṭābat amānim*, 'the red salt of Media' (No. 1 (d)) is to be rubbed into a *NAM.GEŠTIN*-bird, the process of drying being accidentally (?) omitted. It is therefore uncertain whether the salt is intended as a preservative, or has some religious significance. It may be added, however, that there appears to be little difference between the two salts.

¹ For *ṭābtu* as connected with *ṭābu* 'good', with the suggested meaning 'sweetness' (i.e., preventing putrefaction) and the parallel in Arabic of *milḥ* 'salt' and *māliḥ* 'handsome', see Haupt, *BA.* 1913, 246.

² Text re-exd. The 'bi' is a badly-written *nu*.

³ In Mosul I was offered a dried lizard for a similar purpose.

Ṭābtu is eaten with meat: 'like salt on cooked meat' (*kī ṭābtī ana eli širi silki*, *KAR.* 215, iv, 14).

Quantities in early texts (3rd Dyn. of Ur, *AT.* 7, 1). It is usually crushed up, esp. in a mill for lolium (*sahlē*) (presuming that *MUN* here is 'salt', *AM.* 14, 8, 7); or in an *uršu*-mill (*AM.* 24, 3, 14); *kirbanu ṭābtī* is a lump of salt (*Kū.* 125: *ṢRAS.* 1931, 9).¹ The Salt Desert of Arabia is described with this word *ṭābtu* (*PE.* iv, 54).

Use in *MT.*: *Ext.*, brayed with fir-turpentine and roses, in water for head, for *asû* (cf. Pliny, *NH.* xxxi, 45, salt for itch-scabs), *AM.* 1, 3, 8, dup. *KAR.* 202, 1, 36. On eyes, with others, *AM.* 16, 1, 17 (hairs growing and causing pain, cf. *SM.* ii, 102; *PRSM.* 1926, 49): with castor oil in honey, *AM.* 18, 10, 8: with fat and 'scrapings' (*LA.* *ib.* 7 (cf. *SM.* ii, 101, 103, and *IB.* 'to sharpen sight', No. 2164). In ears, sprinkled alone on wool with cypress oil, *AM.* 34, 1, 3 (cf. *SM.* ii, 115): as a lump (*kirbanu*) with others, *AM.* 35, 2, 12: *KAR.* 202, 1, iv, 13. On anus (?), for some form of fistula (?), with 'reduced' ground flour, *KAR.* 191, 4, 7; for *fistula* (?), ext. (?), as a lump, to be brayed with *tatturrû*, *AM.* 58, 1, 5. As mouth-wash, with *AL. UŠ.SA* and vinegar, *AM.* 28, 7, 7 (cf. 78, 1, 17). As *enema* with oil, with ten others boiled in *kurunnu*-beer and cooled, *KAR.* 157, 5 (cf. *AM.* 43, 1, 7, 9, for enemata). For bile, drink alone in water or beer, and vomit (*iarrum*, *Kū.* iii, ii, 73): for stomach trouble (*kīš libbi*), *ib.* i, i, 9: drink alone (as an emetic?) in beer or water, *ib.* ii, 37: to be chewed alone as a lump, *AM.* 52, 1, 16. Uncertain use, *fumigation*, *AM.* 65, 5, 10. *BIL. ṭābtī* (ash and (or, of) salt) brayed and applied *ext.* alone, *AM.* 75, III, 29. Quantities, 10 *kisal*, drink, stomachic, with others, *AM.* 39, 1, 6 (note the small quantity to avoid vomiting); 10 shekels, with others, probably as enema, *AM.* 42, 2, 8. Note 52 mana, *Nbk.*, No. 155. In an uncertain disease a lump is to be bound in the mantle of a sick man with other drugs (*ABL.* 450, 10).

The possible synonym 'stone of blood' is presumably to be kept distinct from 1 (*d*), *ṭābat amānim*, which is likened to blood on account of its colour. Although there does not seem, it is true, to be much actual difference between the two salts, this suggests easily the connexion of salt with blood brotherhood, the introduction of the new-born child into the tribe by rubbing it with salt, and similar symbolic acts. At the same time note that 'F' 6 gives *AMUD* = *aban dāme*, and in *L.* 12 *AMUN* = *aban ṭābtī*, so that here, at all events, they are kept distinct.

Two classes of salt are in use in modern Mesopotamia: (1) the salt deposits of the rivers: (2) the salt taken from the earth, as distinct from (1), which, I presume, is the impure lumps of salt to be seen for sale in the bazars. It must be this latter which is properly *ṭābtu*, although the word probably covers 'salt' in general: but the salt from the rivers

¹ To Küchler's comparison with *kurbani* (*kirbani*) *ša abari* add *RID* (*kirban*) *ṭṭī* 'a lump of clay' (*KAR.* 252, ii, 17).

must also be *tâbat* EME.ŠAL.LIM (see No. 1 (b)). Salt is found on the Ali Dagħ, N. of Tuz Khurmati (20,000 piastres' worth annually, *A.* 240: cf. *Koord.* 28): at Hit (*A.* 85: 'a prodigious quantity of fine salt'): at Koh Tuz 'Salt Hill' near Havagowa, not far from Mardin (*EE.* ii, 348): cf. *Tr.* 353 'all the rivulets that flowed from the sandstone' (near Vihan, near Sert) 'were loaded with common salt, which also effloresced on the banks'. Cf. also *ib.* 365, and *G.* 67, for salt at Kufra, near Sert; about the Persian Gulf, Pilgrim, *MGS.*, xxxiv, 159.

To sum up: *tâbtu*, used in one instance to describe the salt of the desert, was eaten by the Assyrians with meat, and frequently used as a preservative: it was crushed to powder, which (with the mention of *kirbanu* 'a lump') indicates the rough lumps of the bazar: and was used in medicine, especially as an emetic. A distinction is kept between *tâbtu*, salt, properly sodium chloride, *tâbat* EME.ŠAL.LIM, which comes from the rivers, and doubtless contained much sulphate of magnesia, and *mil'u*, which, in spite of its coincidence with the Heb. *melaḥ*, is saltpetre, as pure as the Assyrians could obtain it.

1 (b) Tâbat (MUN) EME.ŠAL.LIM, an impure salt collected 'from the river' for daily use (i.e., 'salt of mankind'), probably sodium chloride with magnesia, &c.

Explained as *tâbat libbi nâri* (*JRAS.* 1924, 455) 'salt from the middle of the river', and [MUN]. *MULU.GIŠGAL.LU* 'salt of mankind' ('X' 7).¹ 'Salt of the river' is a term aptly describing the salt obtained in modern times from the river at Hit and other streams (see No. 1 (a)): 'salt of mankind' is equally definite. Its use in *MT.* coincides partly with that of *tâbtu*, common salt: for *eyes*; eyes full of blood, with many others, *AM.* 9, 1, 34: blow into eye, *ib.* 38 (cf. *AM.* 11, 2, 44): eyes full of . . ., *AM.* 16, 1, 8 (with cantharides): *ib.* 10: blindness after heat of day (amount, *ribātu*) *AM.* 17, 4, 7: for eyes, with cantharides and styx, *AM.* 8, 1, 27 (amount *šišātu*) (for cantharides with eyes, see *PRSM.* 1924, 8: *PE.* 12): as *MUN.EME.ŠAL.LA* with myrrh in lard, *KAR.* 202, 1, 11: uncertain, *AM.* 8, 5, 10: 8, 7, 3: 9, 1, 13. *Teeth* or *mouth*, *KAR.* 213, 3, 4: foetor in *mouth* and *nostrils*, with others, *AM.* 26, 6, 9: yellow *teeth*, *AM.* 31, 6, 7. *Ears* (cf. *AM.* 34, 4, r. 6 and 10): *AM.* 35, 2, 12 (*RID* (?), *kirbanu*, 'lump'?): *head*, *AM.* 64, 1, 37: a complicated *head-trouble*, with eyes, &c., alone in myrrh in eyes in *ḫimetu*-ghee, *CT.* xxiii, 23, 7 (cf. *ib.* 26, 5). As *fumigatory* with others, *AM.* 99, 3, 8. 15 še (grains), *LK.* 60, r. 8 (uncertain use).

¹ We can hardly include here as a certain equivalent *tâbat šadê* 'salt of the mountains', of 'X' 6. For one thing, it is also the equivalent of *MUN.KU.GA* 'clear salt', which I take to be *sal gemma*: for another, 'X' 6 actually has a variant for this of simple *MUN* 'salt' only. In any case it is hardly likely that 'salt of the river' is the same as 'clear salt', 'salt of the mountains'.

The similar use *ext.* for head, eyes, and ears for the two salts 1 (a) and (b), whatever the exact diseases may be, suggests that there cannot be a great distinction between them, and yet there are four points against an actual equivalence:

(1) the long descriptive name, *MUN.EME.ŠAL.LIM*, when there is already the simple *MUN* for what is definitely salt: (2) that *MUN.EME.ŠAL.LIM* is not used as a preservative, while *MUN* is frequent thus: (3) that it is never used in the Glass-texts, which shows that if it be, as we have presumed, some form of sodium chloride from the rivers, it is too impure to use as such (the Assyrian use of saltpetre (*mil'u*, No. 1 (e)) in glass being well known, and there already being one mention of *tābtu* in the Glass-texts, Appendix I, Sect. FF): and (4), that the fact that the bulk of the dissolved salts in the Tigris and Euphrates is bicarbonate of lime and magnesia¹ with some potash (*G.* 14, 15).

The first evidence in its identification, after the definitions 'salt from the middle of the river' and 'salt of mankind', comes from its name *MUN.EME.ŠAL.LIM* (once *MUN.EME.ŠAL.LA, KAR.* 202, i, 11), i.e., a salt by which the tongue (*EME*) is in some way affected (as shown by the difficult group *ŠAL.LIM*). *ŠAL* = *rapāšu* 'be wide, broad' (*D.* 554, 3), and since there is also a word *amEME.ŠAL* = *dibrū* (Smith, *CT.* xxxvii, Introd., and *pl.* 24, ii, 13), the Syr. *dabbârâyâ*, probably 'a man of broad speech', the expression *MUN.EME.ŠAL.LIM* suggests 'salt which broadens the tongue'. This indicates an acrid, biting taste, which would hardly be applied to ordinary salt, which is simply *MUN*, without the difficult additions of *EME.ŠAL.LIM*: at the same time, it is *MUN.EME.ŠAL.LIM* which is 'the salt of mankind' and comes from the 'middle of the river'. I suggest that we have here the ordinary salt which is collected from the river banks, containing impurities, especially sulphate of magnesia ('a very unpleasant bitter taste', *P.* 753). In connexion with its use in *MT.* it may be properly added here that many forms of salt were applied to the eyes in ancient times: in *SM.* ii, 'Indian salt', 89: 'Armenian borax', 90: mountain salt, 97: Armenian natron, 98: Armenian salt, 100. Columella (*De Re Rust.* vi, 17, 7, quoted *HI.* ii, 399) recommends rock-salt, either Spanish, ammoniacal, or Cappadocian in an eye-salve. Pliny (*NH.* xxxi, 46) says that 'nitrous waters' are found, and he prescribes *nitrum* for eyes, teeth, and to cleanse ears and to disperse the singing in them. *IB.* 381 says that *tinkar* (properly borax, which he calls *aphronitron*, foam of nitre), is held by some to be the nitre of Armenia 'of purplish colour, biting the tongue. It comes from a town called Magnesia.'

To sum up: The difference between this salt, *tābat EME.ŠAL.LIM*, and *tābtu*, is that the former comes especially from the rivers, and, as

¹ At the same time my recollection is that the water of the Tigris and Euphrates has no noticeable purgative effect.

its name indicates, affects the tongue: its impurity is indicated by its absence in Glass-texts. The quantity of magnesia in Mesopotamian water suggests that this may be the peculiarity which was noticed in the salt collected for daily use from the rivers and gave rise to its name *MUN.EME.ŠAL.LIM*, which, although defined as 'the salt of mankind' 'from the middle of the rivers', differed from ordinary salt (*MUN*), by having a peculiar taste.

1 (c) *Ṭābat šadê*, *MUN.KÛ.GA*, *MUN.UŠ*, the 'clear salt', the 'salt of the mountains', 'male salt', probably *sal gemma*.

'X' 8, 9. As I suggested in No. 1 (b), it is hardly likely that the term 'mountain salt' is a correct synonym for both 'salt of the river', and the present salt, the former due to a scribal error. Our present salt, definitely the 'clear salt', and as such probably the transparent *Sal Gem* of *HD*. 371, may reasonably be claimed to be the true 'mountain salt', that is, if the latter term is applicable to one only of the two. Of *Sal Gem HD*. gives four kinds: (1) white, resembling sea salt; (2) iron grey, with a little blackish earth mixed with it; (3) red, near the colour of conserve of roses, having a mixture of bole or a kind of rust of iron; (4) the true *Sal Gem*, as transparent and bright as rock crystal. It is easily wrought into little boxes, beads, and crosses, and Lemery (*ib.* 372) says it is used with meat, and in medicine for colic and to open obstructions. *Ṭābat šadê* is used in *MT*. with *ṭābat amâni* (see No. 1 (d)), which suggests a similarity between the two. 'Mountain salt' was a name given to Cappadocian salt in later times (actually a variety of *sal gemma*, Democritus, *HS*. ii, 27); cf. 137 'sel de Narga (?)', c'est le sel de Cappadoce et le sel gemme et le sel d'El Andâr'.

1 (d) *Ṭābat amâni*, the 'red salt of Media', probably the red *sal gemma* of Pomet, the *Andarânî* or *Ṭabarzad* of the Arabs.

'X' 4, 5. *BRP*. 32, 15 (*JRAS*. 1924. 455) gives *MUN. amânu Û.MU.UN: amânu [Û.M]U.UN damu aššu ṭābtu samat ša mâtu Madat 'Ṭābat amânu, Û.MU.UN = amânu, [Û.M]U.UN = "blood", because (it is) the red salt of Media'. 'X' gives the forms MUN.amânim, "MUN.amâni, MUN.amâni, "MUN.sâmtu, as being all equated, thus again representing the amânu-salt as red. It must, I think, be kept distinct from ordinary ṭābtu 'salt', possibly synonymous with *aban dâme* 'the stone of blood', No. 1 (a). The root of *amâni* may be the ordinary *amânu* 'be firm, constant', common in the Semitic languages, i.e., indicating a hard quality, which is attractive, in view of a comparison with the well-known hard red salt called *Andarânî* by the Arabs. Ar-Razi (*MASB*. 375) says that there are two kinds of *Andarânî* salt,*

one white, hard, pure, and transparent: the other red, from which trays are turned. Stapleton (*MASB.*, l.c.) adds that the author of the *Makhzan* says that 'in India it is called *Namak Lāhūrī* (Lahore Salt) as it comes from that town. Salt cellars and cups are made in India from it.' He also quotes (*ib.* p. 346) Leclerc (*IB.* 2164) as saying that the *Andarānī* salt has the name of *Ṭabarzād* in Iraq, which annotates Ar-Razi again (in *MASB.* 347) 'the *Andarānī* is that which is transparent. The *Naftī* is that which has the smell of Naphtha. It is of the same hardness as the *Andarānī*, but is somewhat black and has a smell [because it is found?] in the salt marshes near naphtha wells. The *Ṭabarzād* is hard and impure. The red is hard and (clear) red (in colour).' *IB.* 2164 says that some maintain that the *Andarānī* is *sal gemma*. There is a similarity between it and the Sal Gem of *HD.* 371 (see No. 1 (c)), especially the third kind, the red: and the medical use of Sal Gem as given *ib.* applies to two cases of *ṭābat amānī* in *MT.*: 'when the stomach hurts and the food is returned to the mouth', this drug is to be drunk with 'mountain salt', &c. (*Kū.* i, i, 31, cf. also *ib.* ii, iv, 45). Like *ṭābtu*, *ṭābat amānī* is prescribed also as stomachic (*Kū.* i, i, 10). *AM.* 65, 5, 7 uncertain. It has something in common with *ṭābtu*, common salt (see No. 1 (a)) in the virility charms, in that it is also to be rubbed into the dismembered carcass of a *NAM. GEŠTIN.ĤU* bird, and this is to be given to the impotent man to drink (*MAOG.* 48, 29).

To sum up: the probability is that we have here the hard (i.e., *amānī*), red salt, not differing greatly in composition from ordinary salt, as the similar use of it and *ṭābtu* would imply. Stapleton (*MASB.* 346) says that the specimen of *Andarānī* salt submitted by an Indian druggist was pure salt with traces only of K_2SO_4 , and so, probably, *ṭābat amānī* and *Andarānī*-salt (and Sal Gem) are much the same. There are, of course, other possibilities, as salt may naturally take on the colour of the local soil. Pliny (*NH.* xxxi, 46) speaks of Egyptian nitre beds, with a red produce due to the colour of the earth.

1 (e-i) The efflorescence of the soil, saltpetre, &c.

The following is a description of the salts due to the various efflorescences: (1) on the desert itself: (2) on bricks, of material uncontaminated by animals: (3) on old walls containing ammonia.

(1) Both in Mesopotamia (see *A.* 118) and India (see *SMR.* 59) (doubtless owing to the large use of wood and cowdung as fuel, *SMR.* 59), the soil (presumably near the villages, as *SMR.* explains) contains abundant efflorescence of nitrate of potash as well as carbonate and sulphate of soda. But the Indian *rēh*, the ordinary efflorescence, contains principally the carbonate and sulphate of soda (as well as ordinary salt, salt of lime, and magnesia) (*SMR.* 58: *CPI.* 51: Voelcker, *Imp. Ind. Agric.* 37). Presumably the Assyrians had to deal therefore with

efflorescences containing a mixture which might either include or omit the nitrate of potash.

The method in India of obtaining nitrate of potash consists in 'dissolving out the mixed salts contained in soils around villages, and effecting a first rough separation of the two most prominent salts—sodium chloride and potassium nitrate—by fractional crystallization' (*SMR.* 59). Doubtless this was exactly the method of the Assyrians, who were obliged to obtain a fairly pure saltpetre for their glass-making, and this is certainly indicated by their use of the words 'washed' and 'unwashed' in relation to *mil'u* (saltpetre) in the Glass-texts. To go into further details (*HC.* i, 308 (Marcus Graecus): *HS.* i, 110), to obtain saltpetre the efflorescence is dissolved in boiling water, the liquid decanted, poured through a filter, heated for a day and night, and then the salt which congeals at the bottom, is ready. More elaborately 'saltpetre is prepared by leaching the natural soils containing it, previously adding some carbonate of potassa to decompose nitrates of lime and magnesia. . . . By repeated crystallization it is refined or rendered purer, but still retains chloride. It may be obtained absolutely pure by dissolving the refined salt in boiling water to saturation, stirring it as it cools to produce a crystalline powder, and washing this with a saturated solution of pure saltpetre. . . . It may be kept in this state of powder, or fused and cast into blocks.' (*EC.* 842.)

Probably the Assyrians had the same practice as that of the *Sorawallahs* (a caste of men who collected the raw nitre) in India, who go about the village, examining the surface drains, and by the detection here of a faint veil-like patch of crystalline formation, recognize the presence of nitre. They then scrape off a thin layer of surface soil, put it into an earthen vessel containing water, and this is allowed to evaporate, the nitrate of potash being recrystallized once or twice (see *TC.* ii, 344).

So much for saltpetre obtained from one efflorescence. This, I think, will be seen to be the *mil'u*, No. 1 (e).

(2) On the other hand, the carbonate and sulphate of soda are also obtained in India from the soils (*SMR.* 58), the carbonate being prepared 'from certain earths which contain it, and [it] is found in the Indian bazars in regular whitish cakes about the third part of an inch thick, and appears to contain much muriate of soda' (*MI.* 396). This was in all probability an Assyrian method, too: but we have also to identify a peculiarly special form called *epir asurri* 'dust of the wall' with carbonate of soda (it being used with turmeric in dyeing, No. 1 (g)), which, if it was really made from the scrapings of bricks, was probably impure. Doubtless it was the same substance as the dyers' *nitru* ('nitre', No. 1 (h)). (A distinction must be kept between these and the vegetable alkali, *uhulu*, No. 1 (o)).

(3) But certain medical receipts show that when *samānu ša igari*,

sal murale, 'leprosy of the wall', was employed, ammonia was included (for scab, or similar head trouble). *Sal murale* 'the saltpetre on effloresced walls, the leprosy in houses' was often soda mixed with calcareous earth, but with nitrate of ammonia included (*HI.*, ii, 484). It is found in stones, earth, on old walls, buildings, and the urine of several animals which has lain for a long time on cellar floors (Lemery, *HD.* 376), Pommet identifying it with aphronitrum, the natural saltpetre sticking to old walls (*ib.* 375: *CPI.* 972). In India saltpetre is collected 'from the earth of old walls, scrapings of roads, cow-pens, and other places frequented by cattle' (*MI.* i, 374).

Besides *šamānu ša igari* we have to include other names *ītru*, *ītrānu*, lit. 'smoke', but indicating sal ammoniac, and *IM.KAL.LA* 'sublimate (soot) of (road and other)-scrapings' (Nos. 1 (*j*) and 2 (*h*)). With this introduction we can now discuss these salts.

1 (e) Mil'u, AN.NE, ^aAN.NE, nitrate of potash, saltpetre ('white', 'black', 'male', 'female', 'washed', 'unwashed').

Philologically, its similarity to the ordinary Heb. word *melaḥ* 'salt' would suggest sodium chloride, but the use of the terms 'washed' 'unwashed', apart from the other adjectives, in conjunction with its frequent use in the glass-texts (which actually mention *tāb[tu]* 'salt' once, Sect. FF), at once indicate that this is saltpetre (*OTC.* 28, accepted by Eisler, *ZA.* 1927, 117) (see Appendix i). Both forms, ^aAN.NE and AN.NE are found in the Glass-texts and *MT.* (e.g., *KAR.* 185, 14).¹ In *CT.* xli, 25, 8, K. 2895, ^amil' = NE = me-il' ^aAN.NE. 15 mana of AN.NE (but it is uncertain if it is our word) are mentioned on a Drehem tablet (*TD.* 5529). AN.NE is used as a simile in describing another mineral; *abnu šāšu kima AN.NE u . . . MU.NI ana ênâte^{pl} marši . . .* 'this stone is like AN.NE and . . . its name is . . . (to be put) on the eyes of the sick man' (*KAR.* 185, r. ii, 5, 6).

In *MT.*: ^aAN.NE simply: for eyes, probably *AM.* 85, 2, 8: for *amurrikanu* (jaundice), 15 *še* in *BI.SUD* (*alappanu*-beer?), with purified oil, to be drunk (?), *Kü.* iii, iv, 39: for a swelling, *AM.* 77, 1, 17: urinary trouble, with ^aAŠ.MUR in *himetu*-ghee, to be [introduced by 'filling the middle of his penis?'], the previous prescription being ^aAŠ.MUR alone in *himetu*-ghee, *AM.* 62, 1, ii, 7:² with others, prob.

¹ A form *ZA.AN.NE*, i.e., 'stone+AN.NE' exists in the middle of the Third Millennium: '18 *ZA.AN.NE*' (*TE.* 6044, r. v, 2): '3 *KIŠIB* (seal?) *ZA.AN.NE* . . .' (*ib.* iv, 11): '11 *ZA.AN.NE*, *GÍD.DA*' (*ib.* 13).

² Introduction by the penis presumed from the other receipts, not certain. There is every reason to see antimony here in ^aAŠ.MUR, since antimonious sulphide is used in *P.* 172 (at all events to be taken internally) for secondary syphilis and its cutaneous eruptions, and *antim. tart.* for gonorrhoea (*P.* 1351). *Argenti nitras* is given as a bougie in chronic gonorrhoea, showing that the Assyrians had a similar method (*P.* 184).

drink, *KAR.* 193, 8 (cf. *AM.* 66, 7, 1): *stomach* (*huṣ libbi*), *KAR.* 186, 14; *ghostly seizure*, rub with others (with *šaman būri*, and cedar blood), *AM.* 97, 4, 9: *ditto*, and pain in temples, rub with others on temples, eyes, and neck, *ib.* 26, dup. *CT.* xxiii, 44, 3-5: *KAR.* 182, 10; against *Hand of Ishtar*, *KAR.* 186, 30. In *magic*, thread with black iron ore, *uknú*-blue, &c. (colours of beads) (*BBR.* p. 114, 25) which suggests that *AN.NE* is of a white colour. Cf., for this solidity, the lapidary's list, *ADD.* 993, ii, 14 (re-exd.), '1 *AN.NE a-na* 1'.

^a*AN.NE.PAR*, 'white *AN.NE*': *head*, anoint alone with black *AN.NE* in *himetu*-ghee, *AM.* 1, 3, 5: eyes, apply with others, *AM.* 16, 3, 5: *hinikti KU. GIG* (some form of retention) with twenty-one others (drink?), *AM.* 40, 5, 19: *ghostly seizure*, rub with others with *šaman būri* (some kind of oil) and cedar blood, *AM.* 97, 4, 9: against *Hand of Ishtar*, *KAR.* 186, 30.

AN.NE.GIG, 'black *AN.NE*': *head*, see *AN.NE.PAR*: *eyes*, 'reduce' alone and apply in *himetu*-ghee, *AM.* 15, 6, 12: apply with others, *AM.* 16, 3, 5; 19, 6, 12, 14: *ears* (dullness of hearing), with water of pomegranates, &c., insert, *AM.* 34, 1, 18 (*JRAS.* 1931, 17): *urinary trouble* (kidneys), drink with others in grape juice, *AM.* 39, 6, 9, prob. dup. 59, 1, 26: *strangury*, drink, *AM.* 60, 1, 19: 15 *še* ('grains') with a 'quarter' of pine turpentine in *kurunnu*-beer, drink, *KAR.* 155, 2, 10:¹ *scorpion-sting*, mix with others in cedar-oil and apply in oil, *AM.* 91, 1, 7: *ghostly seizure*, rub with others (with *šaman būri* and cedar blood), *AM.* 97, 4, 9: *ditto*, and pain in temples, rub with others on temples, eyes, and neck, *ib.* 26, dup. *CT.* xxiii, 44, 3-5 and *KAR.* 182, 10: against *Hand of Ishtar*, *KAR.* 186, 30.

^a*AN.NE.GIG.UŠ ù ŠAL* 'male and female black *AN.NE*': *urinary trouble*, drink with others (Lutz, *AJS.* 1919, 82, 86). Simple *AN.NE* is included with *AN.NA* (tin, lead) and *A.BAR* (lead, antimony), *AM.* 5, 1, 3, apparently in a hair-dye (cf. ll. 4, 5, incomplete).

Pliny (*NH.* xxxi, 46) says that nitrum in honey improves the eyesight, and, dissolved in wine, is used for suppurations in ears. *P.* 957 gives it as diuretic (so India, *BMM.* 78), and diaphoretic, and to preserve tinned meat.

^a*AN.NE* is given as a preservative of caper buds (*"nibi" 'balti*), *JRAS.* 1934, 775 (*CT.* xiv. 44, 1-18, &c.), for which vinegar is usual (*IB.* 1328, 1877) but Pliny (*NH.* xxxi, 46) says that Egyptian nitrum is eaten with radishes.

To sum up: *mil'u* is saltpetre obtained from the efflorescence of the soil, used especially in glass-making: fairly frequent in *MT. ext.*, for

¹ *P.* 1199, turpentine is 'said to dissolve gall-stones'; in doses of 1 fl. dr. it is apt to irritate the kidneys, but in small and large doses does not usually tend to. Hence the limited quantity prescribed in *MT.*?

eyes, ears, &c., and *int.*, for urinary trouble. It can be threaded, presumably as a solid substance, and is once used as a medium for preserving caper-buds.¹

1 (f) Ṭābat A.ŠAL.LIM, a form of saltpetre (?).

Probably not merely a badly-written *MUN.EME.ŠAL.LIM*, since it is to be used for a cough, a piece of it dissolving in the mouth, followed by soup of pigs' meat, beer, and honey (*AM.* 80, 1, 12), similar to *P.* 144, for ammonium chloride, a 'stimulating expectorant in bronchitis . . . by allowing it to dissolve slowly in the mouth in the form of a lozenge or tablet'. Since *MUN.EME.ŠAL.LIM* represents salt (with impure Epsom salts with their bitter taste reflected in the Assyrian word), we may perhaps see the effect on salivation indicated by the *A* = 'water' in the other. Pliny (*NH.* xxxi, 46) says that Flower of *nitrum* with galbanum and turpentine is given in pieces the size of a bean for coughs.

1 (g) Epir asurri, 'dust of the wall', (impure) carbonate of soda (the sajji matti of the Indian dyers), a form of sal murale.

To be used especially with turmeric alone ('Chemist's Vade Mecum', *JRAS.* 1934, 780) *'kurkanam ina epir asurri* 'Turmeric (*AH.* 110) in Dust of the Wall'. The salts in Mesopotamian earths include nitre, sulphate and carbonate of soda, this latter being the *sajji* of India (*No.* 1 (e)). Under *Curcuma*, *CPI.*, 448 says that Calcutta dyers obtain a brilliant yellow by mixing turmeric with *sajji matti* (carbonate of soda), and the Assyrians appear to have done the same, by mixing the *epir asurri*, *sal murale*, with it, which suggests that this is the same salt perhaps mixed with nitrate of potash. Carbonate of soda is used in more Western processes for brightening the colour of a dye (cf. *EC.* 531), and Pliny (*NH.* xxxi, 46) says that *nitrum*, when in an impure state, is useful for dyeing.

Epir asurri, presumably the *sajji matti* (carbonate of soda) of India, must differ from the similarly named *samānu ša igari*, in that the latter contains ammonia (as especially used for scab, or similar). Yet *epir asurri ša šaḫi* 'dust of the wall (stye) of a pig', is also a special drug for scab (or similar) (*AM.* 1, 2, 17), and will thus contain ammonia. The distinction, however, may be maintained by pointing out that the clay bricks of an ordinary house-wall need contain no ammonia, while the definite description 'pig-stye' indicates the peculiar form of provenance

¹ What 'male' and 'female' saltpetre are is difficult to say. Presumably the 'black' kind is due to iron impurities in the soil. Note '1 mana ma-al-tum *AN.* *NE* (following '10 mana of silver', and preceding '1 *URUDU UR*₄', *RTC.* 304, i, 14-16, period probably Shulgi).

of the drug necessary. In *MT.*: 1 *kisal e[pi]r asurré*, and . . . *asurré*, are to be bound on in oil (*AM.* 17, 6, 7 and 2).

Note *JRAS.* 1924, 455, 'abukatu-gum is like *epiri asurré*'. Salt-crystals appearing on tablets have a yellowish tinge, and may be compared to those gums which take on the form of little yellow tears.

To sum up: *epir asurri*, *sal murale*, is used in dyeing with turmeric, which indicates carbonate of soda, although its source of origin may include other impurities.

1 (h) Nitiru, nitru, carbonate of soda.

Boson (*It.* 975). Heb. *nēthēr*, Syr. *nethrā*, prop. carbonate of soda, mentioned *ABL.* 347, r. 8-9, after red and black wool,¹ (30 talents of *agabū* (alum) and 10 talents of *nitiru*) obviously a dyer's memorandum, the alum being, of course, the well-known mordant, and the carbonate of soda used to brighten a madder dye on cotton (in a cold dilute solution) (*EC.* 531) or turmeric, as in the preceding. In *MT.* 2 shekels each of *nitru*, *agabū* (alum), and sulphur are to be used for anus trouble (haemorrhoids ?), *KAR.* 198, 10. Whether *nitru* represents the same substance as the preceding *epir asurri* is difficult to say. But it is clearly used by the dyers, and as such will probably contain carbonate of soda and perhaps nitrate of potash. It is not used in the Glass-texts, where alkali is *uhulu*.

1 (i) Samānu ša igari, 'scab of the house-wall', a form of sal murale, nitrate of potassium and nitrate of ammonia.

Samānu is a disease, particularly of the head, and ext. treatment is prescribed, *AM.* 1, 2, 10, 13, 17 [20]. In *CT.* xiv, 10, vii-viii, 17, restored from *Mat.* 88, 3, 40, *samānu ša GIŠ.ZI* (= *igari*)² = *tultu sām̄tu*, i.e., '*samānu* of the wall' = 'red worm' (connected with the root *sām̄u* 'be red', as apparently the Assyrians thought). From our evidence it must be ringworm (connected even in more modern times incorrectly with a worm): 'ringworm of the scalp is recognized by loss of hair in one or numerous patches of a circular or oval figure. . . . Occasionally, however, the patch is bordered by an inflammatory ring. . . . On the body it forms red, slightly raised rings. . . . The ragged stumps [of the hair] suggest the idea of having been eaten off by the grub of a tineo or moth' (*DM.* ii, 1377). In *CT.* xiv, 41, Rm. 362, 6 (cf. *AM.* 41, 3, 6) a special plant is prescribed with oil for this disease *samānu*.

Samānu ša igari as a drug is prescribed ext. for *guraštu* (itch), *AM.* 17,

¹ Apparently: 80 talents of *šipatu DIR šadī* and 7 talents of *GIŠ šadī* (omitting *šipatu*).

² That this is certainly *igari* here is clear from the variants *taslamti GIŠ.ZI* in *Mat.* 88, 3, 52, and *taslamtu Ē. MURGU* (= *igaru*), *CT.* xiv, 45, 5.

1, ii, 4, and for *kurari* (itch, of the head, presumably), *AM.* 65, 5, 21 (*RA.* 1929, 72). For *samānu* alone as a drug, see *AM.* 7, 3, 3.

From the suggestion of Professor Nevil Sidgwick, I take this to be a form of ammonia (*PRSM.* 1924, 3) (cf. No. 1 (g)), ammonia being a powerful rubefacient (*P.* 132). Perhaps another form is *tasme ša igari*, also for head (*AM.* 1, 3, 6): *TAS.ME.A* = *sāsu*, moth (*Mat.* 91, 25), and *TAS.ME.ME* = *samānu* (*ib.* 26). Cf. also *taslamti igari* = *bir-birānu* (*Mat.* 88, 3, 52, and *CT.* xiv, 45, 5).

1 (j) *Iṭru, iṭrānu*,¹ *SAḤAR.SIS* ('bitter dust'), *KI.NE*, properly *sal ammoniac*, but generally for *salt efflorescence*. (Cf. *IM.KAL*, *IM.KAL.LA*, Nos. 2 (h) and (i).)

These, meaning lit. 'smoke' and probably 'soot', are loosely used. Haupt (*BA.*, 1913, 250) quoting *SAḤAR.SIS* = *iṭrānu* (*CT.* xix, 41, K. 4328, iii-iv, 8) makes it 'salt-swamp, saline dust', the Indian *rēh* (see No. 1 (e) ff.). Sidney Smith explains it as the salt which is the cause of the loss of fertility in Iraq (*RA.* 1925, 64), Gwynn (*PSBA.* 1914, 243, 28: cf. *CT.* xl, 2, 28) 'alkali', and Pinches 'l'essence' (*PSBA.* 1909, 64). While accepting a wide significance, I believe the exact one to be *sal ammoniac*.

KI.NE, lit. 'fire-place' = *iṭrānu*, *kūru* (furnace), *kinunu* (brazier), *nappašu*² (chimney), *iṣatum* (fire), *pēntum* (coal), *tumru* (ash), and *nī-mirtu* (from the same root), and finally *tābtu* (salt) and *martum* (gall) (*CT.* xi, 50, 10-25) and cf. *HRET.* No. 37, 17. *CT.* xix, 1, K. 55, gives *kūri* and *nappašu*, as equated with *DI.NI.IG*, and *kūḫu* (*kūri*?) and *iṭrānu* with . . . *NI.IG*.

Beginning with the equivalence *tābtu* 'salt', we find both *iṭru* and *iṭrānu* used for the efflorescence on the desert (see 1 (e) ff.). Sidney Smith (*RA.* 1925, 64) reading *idru*, quotes *MMAF.* vi, 41, iii, ii, 9-11, ^{ilu}*Adad gugal šamē u iṣiti iklēti-šu iṭra lišashima* 'may Adad, the *gugal* of heaven and earth, cause *idru* to destroy his fields'. *Ib.* 63, he quotes *kimu urḫiti iṭranu kimu* ^{ilu}*Nisaba pūkuttu liḫnubi* 'in place of grass may *iṭranu* grow, in place of corn may thistles abound' (King, *Boundary Stones*, 41, 33); [*kī*]^{mu} *ŠE.BAR larda kimū mē^{pl} iṭrana lišabši* 'in the place of grain may (Adad) cause to be *lardu*, in the place of water may he cause *iṭrānu*' (*ib.* 62, 11-14). In the Atrahasis myth, *CT.* xv, 49, iii, 47-8: cf. ii, 32-3, *lini² irta ša* ^{ilu}*Nisaba: mušāti^{pl} lipšu ugārē^{pl} šēra*

¹ The form *iṭrānu* is the same as *šadānu*, the 'stone of the mountains', and *argamānu* 'purple'. Can *argamānu* be a doublet alongside the Heb. *karmīl*, crimson, through a normal metathesis of *r*, *m*, *n*, *l*, perhaps both being referred to the base of the word from which comes the Arab. *kirmiz*, the *Coccus Polonicus*, used by the Turks for dyeing (*PC.* xi, 52), i.e., the Persian *kirm* 'worm' (*Gesenius, Briggs-Driver*, 502)?

² 'Breathing passage', *AM.* 16, 4, 8 (*RA.* 1929, 71).

palkû lulid iṭrânu 'May the corn be 'turned back': o' nights may the fields whiten, may the wide desert bear *iṭrânu*'. *CT.* xxxix, 6, *Rm.* ii, 306, 5, adds *iṭrânu*, to *tâbtu*; 'When a field *tâbat KI.NE* (= *iṭrâni*) *RA.*...' Evidently literary texts accept *iṭru* and *iṭrânu* as the efflorescent salt of the fields.

But both words go farther than the salt of the desert, and include that which exudes from the bricks (doubtless of unburnt clay) of the house wall: *šumma iṭru ina bīti u igari ittabši* 'if there is *iṭru* on house and wall' (Gwynn, *l.c.*, translating it 'alkali'), and Smith, *l.c.*, 57, a building *imu karmis libnassu iṭrânim ikmû ṭitalliš* 'was like a ruin. Its mud-brickwork *iṭrânu* burnt like ashes.' Here, presumably, we have also either nitrate of potash or sodium carbonate (as Smith says, the salt which causes the loss of fertility). There is as yet no reason necessarily to translate *sal ammoniac*.

But *MT.* also indicates *sal ammoniac* (a rubefacient, *P.* 132, from camel dung, for itch, in India, *BMM.*, 74): *iṭra ša tâbti taḳallu (tagallu) ina šamni kaḳḳadsu tuḳašša*, *AM.* 1, 2, 9 (paralleled by a similar receipt in the same line, where [*KI.A.AN.I*]D 'sulphur' replaces our drug) 'thou shalt burn *iṭra* of salt, in oil cool his head' (the preceding line being for itch-scab or similar). The directions to 'burn' *iṭra* of salt indicate the method of obtaining *sal ammoniac* from burning dung, which could not apply to saltpetre or Epsom salts.¹ Note also that *taḳallu*, 'thou shalt burn', applied here to sulphur (if my restoration is correct), indicates the sublimation to 'flowers of sulphur' (for scabies, *P.* 1178).

CT. xxxix, 14, ll. 16, 17 (*DA.* 61, 20, 21, and *Ch.* 241, *K.* 47, ii, 20, 21) also appear to show *sal ammoniac*: *šumma nâru kima iṭri pī iḥammatu*, and *šumma nâru kima iṭri tâbti iḥammatu*² 'if a river burns the mouth like *iṭru*', and 'if a river burns like *iṭru* of salt'. This is reminiscent of the description of Ar-Razi (*MASB.* 347) of 'uḳâb, *sal ammoniac*, from Khorasan and Samarcand: 'this is so pungent that it burns the tongue', the 'biting and saline' tastes of *sal ammoniac* (*EC.* 146) being offensive, in comparison with the 'cooling saline taste' of saltpetre (*P.* 957), the reference in the Assyrian omen being presumably to the Epsom salts in the Mesopotamian rivers. (*Iṭri tâbti*, a curious phrase, is expanded in *AM.* 1, 2, 9, to *iṭra ša tâbti*.)

Sal ammoniac is made from the soot obtained by burning camel dung (*EC.* 146: *HD.* 251). According to Hasselquist (quoted by Linnaeus) the modern Egyptians made *sal ammoniac* by collecting the dung of cattle, selling it as fuel, and then the soot was collected and sold to the *sal ammoniac* makers (*EB.* xith ed., xxiv, 59). It must have been known to the Hindus ever since they burnt bricks with the manure of animals (*AHM.* 40). The process among the Hindus for making ammonia is to

¹ An instance of *iṭ-ra*(?) applied to the anus, *KAR.* 201, 25.

² Text re-exd., and, as usual, Mr. Gadd is right.

take two parts of chalk to one of *sal ammoniac*, dry the two, mix, and sublime with a strong heat (*MM.* i, 367). The Assyrian word for it, *ītru*, is obviously the same as the Syr. 'eṭrā 'smoke, fumigation', which makes our identification certain. *Ītra ša ṭābtī*, lit. 'smoke of salt', will be the more elaborate phrase for it, as may be paralleled from Pomet (*HD.* 251, quoted above) on 'Sal Armoniack', made from human or animal urine, common or sea salt, and chimney soot, boiled all together, and sublimed into a salt. It is not used in the Glass-texts, which is very strong evidence that it is essentially *sal ammoniac*. This connexion of *ītru* and *ītrānu* with burning has, of course, been noted, but only, I believe, as evidence that the result of the burning was potash or soda, with which I am unable, for the reasons given above, to agree. Landsberger (*KK.* 121) says: 'Daher das Ideogramm *KI.NE* ("Feuerstätte"), mit Lesung *nemur* (vgl. *NE.MUR* = *kinūnu*, *tumru* auch = *ṭābtu* "Salz") und *it/drānu*, womit wohl das als Endprodukt der trockenen Destillation von Pflanzen entstehende Pflanzensalz gemeint ist (Pottasche, Soda; *idrānu* findet sich anstatt Getreide auf Feldern, Stellen in den WBB. und bei Hinke, BE., Series D, iv, 248)', and he compares Kugler, *Sternk.* ii, 1, 115², 'danach "Soda" od. ä. Aram. 'eṭrānā "Teer"' (Zimmern, *Akkad. Fremdw.* 60), and Jensen, *ZDMG.* lxvii, 509.

To sum up: *ītru* and *ītrānu* (connected with the Syr. 'eṭrā 'smoke'), used for head diseases, compared to a 'burning taste' in water, and above all, absent from the Glass-texts (where potash is a proper component, and ammonia unexpected) are sometimes loosely used for the ordinary salt efflorescence, but must be properly the soot from dung-fires, *sal ammoniac*. The alkali of the Glass-texts is definitely *uḫulu ḫarananu* or *digmen uḫuli* (vegetable ash from salicornia), while on the other hand the common Arab fuel of Mesopotamia is cow-dung or camel-dung.¹

1 (k) [MUN . bu (?)]-ú(?) -ri, "ṭābat bu-[u-ri?], lye, carbonate of soda ?

'X' 12. There is no certainty about the reading, or we might have compared the Heb. *bôr*, *bôrîth*, 'lye', the latter (*bôrîth*) being an impure carbonate of potash, made by filtering water through vegetable ash, and then evaporating the filtered liquid to dryness (*HC.* 326).

1 (l) "Ṭābtu barikatu, MUN.IN.TU.RA, borax (?). (Cf. Syr. *burkā*, and Arab. *bôrāk*.)

'X' 10. That *bôrāk* is not true borax, but is applied to various alkaline salts, is shown by Berthelot (*HS.* ii, 145). His Arab. text gives seven kinds of 'borax': (1) for bread (Ibn Wafed, *IB.* 381, mentions that the bakers of Cairo dissolve it in water and wash the outside of loaves to make

¹ *IM.KAL.LA* (No. 2(i)) appears also to mean *sal ammoniac*.

them shine): (2) natron, redder than the preceding: (3) borax of the goldsmiths, white, like saltpetre: (4) saltpetre, found at the bottom of wells: (5) frothy (?) borax, the best: (6) 'borax of the willow (?)', white: (7) *tinkar*, worked borax. *MASB.* 347, quoting Ar-Razi, gives six kinds; 'bread borax' (see 1 (m)), *natrun*, goldsmiths', Zarawandî, 'of the willow', and *tinkar* (i.e., gold solder). The significance of *barikatu* is thus uncertain.

Borax is found near Urmia and Kerman (*G.* 66).

1 (m) MUN.KÛ.PAD.DA, bread borax (?)

'X' 11, defined by Pick's copy as 'MUN.KÛ.PAD.DA in Akkad'. *KÛ.PAD.DA* suggests something bright, but the equivalence *šibirtu* (*D.* 469, 53), particularly when connected with copper, indicates the broken rough lumps (cf. *siparri šibirti*, 7 (a), with *KÛ.PAD.DU siparri*, 'Y' 6, the preceding line containing *KÛ.PAD.DU.NITA* 'male *KÛ.PAD.DU*', although not necessarily the salt). The 'bread borax' of No. 1 (l) is described as being formed in great, hard lumps (*HS.* ii, 145).

1 (n) Tâbat mânu, MUN e-'(?) -ri.

'X' 14. Unknown.

1 (o) "Uḫulu, "Uḫulu ḫarnanu, "ELTEG, "ELTEG.SI, alkali.

Properly a vegetable chemical. *Uḫulu* has long been identified with Syr. *aḫlā*, lye (*HWB.* 43); *uḫulu ḫarnanu* 'horned alkali' is *salicornia*, the name of two species of the alkaline *Chenopodiaceae* abounding in soda (*AH.* 116: *OTC.* 12). It is the alkaline component constantly used in making Assyrian glass, either as *digmen* (ash) *"uḫuli* (Appendix I, Sect. B), *di-ig-mi-nu ša "uḫuli ḫarnani* (Sect. P), *"uḫulu* (Sect. S), *"uḫulu ḫarnanu* (Sect. T, &c.), and *"uḫulu ḫarṣu la taiaru* (sharp pieces, not round lumps?) (Sect. F).

The adj. *ḫalāti* 'burnt' is appended in *AM.* 7, 7, 4.

Soda ash for glass was brought from the Levant in the Middle Ages (Bacon, *Nat. Hist.* viii, 770, quoted Fowler, *Arch.* xlv, 95, note), that from Baghdad being obtained from the *Salsola kali* (Dillon, *Glass*, 12), and the Arabs still obtain lye from these alkaline plants (*ESR.* i, 574, and see under *"AD.BAR*, 21 (e)). To obtain the lye in India, the sun-dried plants are burnt in pits, the fused alkali collecting at the bottom (Kanchoba Ranchoddas, *Indian Medical Plants*, 1069: for a full description, *BMM.* 76). In *MT.* it is prescribed: (simple *uḫulu*) to cleanse mouth, *AM.* 54, 1, r. 9: (with *ḫarnanu*) eyes, *AM.* 9, 1, 30: 16, 1, 8: 17, 4, 9: 19, 6, 12: anus, *AM.* 53, 9, 11: wash the patient, with many others, *AM.* 3, 5, 9: 94, 2, ii, 9: 98, 3, 3: and many other uses (*AH.* 115).

Mr. A. B. Searle, to whom I have had recourse in problems of glass manufacture, has kindly pointed out to me that in the Assyrian glass receipts the proportion of alkali is excessive, and he has suggested to me that it may be due to the alkali being very impure. He instances the components of *siršu* glass, and compares the normal proportions:

<i>Siršu</i>		<i>Normal Glass</i>	
Sand	100 parts	Sand	100 parts
Crude alkali	300 parts	Sodium oxide	15-22 parts
Saltpetre	8 parts		
Chalk (lime)	3 parts	Lime	7.5-10.5 parts

He says that to make *siršu* equivalent to normal glass, the 300 parts of crude alkali would have to consist of

	<i>Parts</i>	<i>Per cent.</i>
Sodium oxide*	15-22	5-7
Carbon dioxide*	11-15	4-5
Calcium carbonate	4-7	1-2
Impurities (other than soda, potash, and lime compounds)	256-270	85-90
	300	100
*Soda ash	26-37	9-12

'This', he says, 'is an almost incredibly impure material and suggests vegetable matter rather than alkali.'

I suggest, therefore, that the Assyrian chemist is giving the weight of the alkali before it has been burnt, i.e. the raw, dried plant as one sees it constantly in the Arabic bazars as *sh'nan*, desiccated and brittle, looking much like a very small and thin vermicelli, broken up small. For instance, wheat straw gives 4.4 per cent. ash, and pea-stalks give 5.947 per cent. ash, and presumably the dry *sh'nan* will not give a smaller proportion, and hence 300 parts alkali in the Assyrian glass, if reduced to ash (reckoning 5 per cent. as the approximate proportion), will give a proportion of 15 for *siršu* glass, which is what is wanted. We may assume, therefore, that the weight given for the alkali in the Assyrian glass-receipts is for the crude vegetable before reduction to ash.

1 (p) ^aTâbti šikkati, ^aDÛ.ŠUB.BA, alum (see No. 58).

2. THE CHEMICAL EARTHS DEFINED BY SAĤAR 'DUST' AND IM 'CLAY'

- 2 (a) *Epiru*, SAĤAR, dust.
- 2 (b) *Ṭiṭtu*, IM, clay.
- 2 (c) *Gaṣṣu*, IM.PAR, gypsum, plaster (see No. 18(b)).
- 2 (d) *Šarše(r)ru*, IM.DIR, IM.GUŠKIN, 'red clay', ferric oxide.
- 2 (e) *Egā*, *damatu*, IM.SIG₇, IM.SIG₇.SIG₇, 'yellow clay', orpiment (see No. 4(h), (i)).
- 2 (f) IM.GIG, 'black clay' (soot?).
- 2 (g) *Kadu(t)tu*, IM.GŪ, *ṭiṭtu*, deposit, mud, leaven: *ḫadut šikani*, *šiknu ša nāri*, IM.GŪ.EN.NA, leaven of dough set aside, deposit of the river (mud): IM.GŪ.GAR.RIN.NA, leaven of bread: &c.
- 2 (h) *Aklu*, *isikku*, IM.KAL, soot, sublimate, esp. chloride of ammonia, *sal ammoniac*. (This latter meaning is probably an abbreviation of 2(i)).
- 2 (i) IM.KAL.LA, 'sublimate of scrapings', *sal ammoniac*. (LA, *ḫaṣbu*, has various meanings: potsherd, shell (of egg), rind (of pomegranate), shell (of crab), and particularly scrapings of the furnace, sublimate, or of the roads, dried dung.)
- 2 (j) IM.KAL.GUG, 'sublimate of the red (= cinnabar)', mercury.
- 2 (k) IM.KAL.KUKKU, doubtful.
- 2 (l) *Kaḫū*, IM.MAL.LI, yellow ochre.
- 2 (m) *Kalgugu*, IM.MAL.LI.GUG, red ochre (obtained by heating yellow ochre).
- 2 (n) *aGabū*, IM.SAĤAR.TĀK.KUR.RA, alum.
- 2 (o) *Amna(k)ku*, *immanakku*, *aIM.MA.NA*, *aIM.MA.AN.NA*, the white sand for making glass (see No. 17(a)).

2 (a) *Epiru*, SAĤAR, dust.

Usually for magic, although perhaps sometimes with medical value. The following are simply magical: Dust from four cross-roads, from the fore-threshold, from the upper and lower *pisannu*, from the *pisannu* of the door, put into a GAR.GAL.GAL.LA-reed and roll it downwards on the *ḫupi* (?) stomach of a woman with flooded uterus, KAR. 196, iii, 46: from four cross-roads, *ib.* 194, 9 (in red wool); AM. 65, 7, 1: surround neck, AM. 97, 4, 18: for ghostly seizure, i.e., dust from a ruined city, from a ruined house, from a ruined temple, from a grave, from a 'ruined' canal, and from a road . . . mix with ox-blood, KAR. 184, r. 4: from a grave, against ghostly seizure, 182, r. 36: from an old grave, for ghosts, sprinkled on a double thread, CT. xxiii, 18, 45: from the *nimit* of the threshold of the Great Gate, KAR. 186, r. 23, for AN.TA.ŠUB: (for other instances of dust from gates, see LK. 6, 10: 10, 28: 11, 29): from a fallen ruin, alone with *arzallu* (*Crataegus azarolus*?) in cedar oil to anoint temples, for ghostly attack on neck, AM. 97, 4, 23: from the footprint of one unseen, of a woman who has not borne a child, of a black dog, CT. xxiii, 10, 23-4: of human skull, against ghosts, *ib.* 22, 39, 45, and prob. 42: from the root of caper, against ghosts, on

double thread, *ib.* 18, 46: used *ana išdih sabi* (for the success of a tavern-keeper), see *KAR.* 144, 1 ff., *MVAG.* 1918, ii, 40, 1 ff. There is, however, no need to prolong the list here.

Instances of *SAḪAR* 'dust' used with true medical intent are: for *samānu* (itch, or similar) in head, with others, dust from the limestone threshold of an old house, *AM.* 1, 2, 13: for *ra'sanu* (similar) in head, the same, with others, *KAR.* 202, 33: for head, dust from a pigstye, doubtless for the ammonia (see No. 1 (g)) *AM.* 1, 2, 17: dust from an oven, to apply to an affected part, *AM.* 44, 1, ii, 7 and 11 (as potash?): and perhaps even the dust of various dungs, as in that of dog and pig used ext., *AM.* 98, 3, 17: and of *nibilti* (dung) of dog alone in oil to anoint stomach of a woman in difficult childbirth, *AM.* 67, 1, i, 10: or the dust of the *samit*¹ of a ruined wall, &c., in *NI.BUR* (a form of oil, *JRAS.* 1924, 456), mix, rub on woman with flooded uterus (*KAR.* 196, iii, 7 (for the sake of the ammonia?)) (see No. 1 (i)).

2 (b) Ṭiṭṭu, IM, clay and similar earths.

It is clearly clay proper from *CT.* xi, 31, 31, a, where *IM* = *duppu* 'clay tablet'. Aruru kneads *ṭiṭa* 'clay' into a man (*GE.* 1, 34), the word *nādū* describing her action. This latter occurs as *nādū* = *nādu ša ṭiṭṭu* (as values of *NA.RŪ.A*, 'C' 27: 'D' 6), probably the technical word for 'throwing' clay. It is unnecessary to quote the numerous instances of making figures of *IM* in the magical texts. Cf. *IM.NU.DUL*, 'clay mixed with straw' (*D.* 399, 58), *IM.IN.NU* 'clay mixed with straw' (*ib.* 109), *IM.IN.NU.RI* 'clay mixed with chopped straw' (*ib.* 110), for making bricks. Mortar is *IM.NĪK.IB.ZUN*, *ṭiṭ ulapi* (*VR.* 42, 24, g; *HWB.* 75: Thureau-Dangin, *RA.* 1914, 87).²

In *MT.* *IM* has sometimes the meaning 'pus': *IM uṣṣi* 'pus will come forth' (*KAR.* 192, 1, 14) a prescription for *kabartu* (swelling).

2 (c) Gaṣṣu, IM.PAR, gypsum, plaster (see No. 18 (b)).

¹ Surely the *samitu* of a wall must be the base where the urine will have been deposited (see *GE.* 71). As 'bastion' cf. Schott, *ZA.* 1934, 93.

² For *ulapu* cf. *JRAS.* 1924, 453, *KU.NĪK.IB* = *ulapi*, *ŠU.LĀL* = *lubbutum*, *KU.NĪK.IB.ŠU.LĀL* = *šēr šelabi* 'fox flesh'. *ŠU.LĀL* is from *LĀL* 'bind': *ulap lubbutim* = *ḫarnu*, the Arab. *ḫarana* 'bind' (cf. *HWB.* 597) = *ṭenu* (Arab. *ṭin* 'clay', rather than Syr. *thettā* 'glue'). *Lubbutum* must be from Arab. *labada* 'to glue', so that *ulapi lubbutum* will be the ordinary glue made from tannin refuse. The expression 'fox flesh' may be an alchemist's method of concealing the word, but it is worth mention that *EC.* 673 says that glues of a second grade are made from the skins of wild animals. (For another instance of 'fox flesh' = *KU.NĪK.IB.ŠU.LĀL* see *CT.* xxxvii, 26, I, 17.) Used in *MT.* in fumigations (for the ammonia?), *AM.* 93, 1, 12: *ears*, 35, 1, 5: 38, 2, r. 2. As unguent, 19, 2, ii, 7: cf. 29, 1, 3, &c. (see *PRSM.* 1924, 14).

2 (d) Šarše(r)ru, IM.DIR,¹ IM.GUŠKIN, 'red clay', ferric oxide.

In KAT³. 649, identified with Heb. *šāšēr* 'red paste'. 'P' 17-20 give as equivalents of *šeršerru* (*šaršarru*), *ŠIM* . . ., *ŠIM.DIR* ('red *ŠIM*'), *ŠIM.GUG* ('red *ŠIM*'), and of *šaršeru* (or *šeršeru*) *IM.DIR* ('red clay'): 'R' 24-7, of *šaršerum* (or *šeršerum*), ⁴*IM.DARA*,² ⁴*IM.DIR*, ⁴*IM.GUŠKIN*, and ⁴*IM.GUG*: 'S' 9, *IM.DIR* = *šā-ar-šēr* (*šar*)-*ru*. In CT. xix, 21, K. 4362, 32-3, *IM.GUŠKIN* and *IM.DIR* are both probably equivalents. *JRAS.* 1924, 455, *IM.DIR* = *šaršarri* (or *šeršerri*). Cf. the omen 'Y' 8. Apparently used to 'anoint' the eyes of a lionheaded figure (*KAR.* 227, 25). The following colours are used to paint small figures of clay and wood (*KAR.* 298, 26, Sidney Smith, *JRAS.* 1926, 696): *IM.PAR* (gypsum, white), *IM.GĪG* (probably soot, black), *IM.DIR* ('red clay'), *IM.KAL.LA* (soot of ash, grey, No. 2 (i)), *IM.SIG₇*, *SIG₇*, (orpiment, gold), *IM.KAL.GUG* (mercury, silver) and *IM.PAR* (gypsum) 'with water portrayed on it in black'. In *BBR.* 46, 23, *IM.KAL.LA* is replaced by *IM.MAL.LI* (*kalū*, yellow ochre).

It is obviously a red colouring material, but we may eliminate, as being already identified, the following, which might otherwise have been possible identifications: Cinnabar (*GUG*, in *IM.KAL.GUG*, 2 (j)): Red Ochre (*kalgugu*, made by heating the yellow ochre, 2 (m)): and Red Lead (*sāsu*, *ZA.TU.BE*, No. 16 (a), made by heating white lead). *Šaršerru* will probably be one of the red earths of Pliny (*NH.* xxxv, 13, 14) such as rubrica (the milto of Theophrastus 'sometimes found in iron mines'), or sinopis. In the Glass-texts (*OTC.* Sect. MM: Appendix 1, MM) 'If (it is for thee to make) *ši-ir-du-(u?)* . . . *šar-še-ra* . . . put in the midst . . .'. *Širdu* (*širdū?*) is thus a material to be made presumably in glass. I need hardly mention the great popularity of imitation glass gems in antiquity, and (since the Glass-texts are not consistent in their use of *abnu* as determinative before all the minerals which they quote) possibly we may see in *širdu* an artificial sard (Syr. *sar'dān*, Greek sardion, a deep brown carnelian), made with ferric oxide, which is one of the colouring agents for red glass, thus making *šaršerru* coincide with one of the iron earths. Uncertain.

Red clay is still used in Mesopotamia as a coating for walls (*Koord.* ii, 41). Is there any connexion philologically between *šaršerru* 'red ochre', and the Wadi Tharthar, west of the Tigris, in the red sandstone district?

¹ This has nothing to do with *hazaluna*, an error of Meissner's *SAI.* 6284, uncritically repeated by *D.*, No. 399, 100, *e.* In *CT.* xiv, 45, 10, Col. iv is not part of Cols. v-vi.

² 'P' 15 gives this as *hāpu* 'bank' (i.e., the mud on the bank (see No. 2 (g))).

NA, which I suggested in *RA*. 1929, 63, based on the assumption that *GAR.RIN.NA* was the same as the sign *RIN* with *GAR* within it, an oven. With this withdrawal we can start afresh.

IM.GŪ, *t̃tu*, is, as is obvious from the above quotations, certainly 'mud' in one of its meanings. This must equally be the case in the longer expression *IM.GŪ.EN.NA* in its equivalence *šiknu ša nāri* 'deposit of the river', the Syr. *šeknā* meaning *depositum*, *sedimentum* (Jensen, *KB*. vi, 476), and the synonym for this, *hāpu*, the Heb. *hōph* 'bank' (see *AH*. 258) shows that the idea of the 'deposit' is that of the fine mud left by the rivers after they have subsided after the annual floods. So far so good.

The *IM.GŪ* group has a very diverse series of meanings, dependent on the word *kadū*, *kadutu*, accepted as 'mud', 'slime' (*Schlamm*) (e.g., *Getr*. 147, and *D.*, 'Satz' 399, 79, *d*, following Jensen), and again as yeast (*Hefe*) (*Kū*. 102) in the special group *kadut šikari* (*BAG. ib.*; *D.*, 399, 82, 83 making it *Biersatz*, dregs of beer). But simple *kadū*, *kadutu* must, I think, be 'yeast' 'leaven', even when the descriptive *šikari* 'beer' is omitted. In proof of this, to begin with, we have definitely as is accepted, the meaning 'yeast' in *IM.GŪ.BI.TIN.NA*, *kadut šikari* ('yeast of beer'), = *šuršummu ša kurunnu* ('yeast of *kurunnu*-beer', *Kū*. 102). We need have no doubt of Küchler's translation 'yeast of beer' for the synonym *šuršummu ša kurunni*; *AM*. 66, 7, 4 and *KAR*. 193, 13, give 'if a man's urine is like *šuršummi šikari*, yeast of beer', as indication of turbidity of the urine, which admirably supplement this explanation. The cognate must be (*PRSM*. 1926, 71) the Heb. *samar*, in *Pi*. 'remove the dregs' (yeast) from wine, *š'mārīm* being 'lees, yeast'. In *MT*. *šuršummu* is prescribed fairly frequently (something less than twenty times in *AM*.): rarely of 'beer and strong beer' to knead drugs for *mišittu*, a bruise or swelling, *AM*. 76, 5, 8; of 'old beer' for anus trouble, *AM*. 53, 3, 3: to (knead) drugs for *kurari* (itch) *AM*. 5, 5, 2: of beer, to knead *sahlē* (lolium) for eyes, *AM*. 12, 8, 8: to knead drugs for *kaḫli* (pubes) and flesh, *AM*. 61, 2, 12: &c. Yeast is antiseptic and stimulating (*P*. 1236). Finally, *cf.* the occurrences of *kadutu* (*ADD*. iv, 329) in connexion with bread.

Yeast rises to the top of fermenting malt liquor (*EC*. 626), and our comparison with river mud suggests that the deposit of the river is that which is brought to the bank in foaming or fermenting waters. The word *kadutu* philologically means 'a profit', Syriac *kaḫdi* 'gained', while *šiknu*, in its meaning 'deposit' from *šakānu*, suggests something left behind. With this in mind it is not hard to accept *kadutu* as leaven, that portion of the dough of the preceding day which has begun to ferment, and by its addition to the fresh dough causes the latter to rise. Yeast added to wort for fermentation produces a white, milky-looking froth which spreads gradually over the whole surface, and gradually changes its colour to bright brown, owing to oxidation from the air (*EC*. 300).

Returning to the simple *IM. GÚ*, we have a final and most convincing proof for its use simply as 'leaven' in the phrase in *MT.*, *UD. DA DI. DI*, which I have wrongly explained in *RA.* 1929, 50, as 'dried in the sun'. The association with 'leaven' at once suggests the meaning 'held back for a day' (*DI. DI, SILIM. SILIM* = II. 1 of *šalāmu* 'preserve'), e.g. 'If ditto (i.e., when a man's head *NE. NE-im ŠAR-ab*) *IM. GÚ UD. DA DI. DI GAZ NAM*, leaven kept back for a day thou shalt pound, sift' (*CT.* xxiii, 31, 62 and cf. *AM.* 78, 7, 7) (the recipe in the line before prescribes, instead of leaven, wheaten flour to be bound in rose-water on the head). This is expanded in *AM.* 72, 2, 13 to [*IM.*] *GÚ ša ina UD. DA di-kát* (= *DI. DI*?) *GAZ. NAM*, and *AM.* 31, 7, 10, must probably be restored similarly, *IM. GÚ ša UD. [DA DI. DI]* (Cf. also *Kū.* ii, iv, 1, ... [*UD.*] *DA DI. DI GAZ NAM*). 'Leaven' would thus appear certain.

We can now return to *IM. GÚ. EN. NA* with the meanings 'deposit of the river' and *kadut šikani*. First, *šikanu* can hardly be the same as *šiknu*, the two words being in the same line, and if the grammarian had meant to write the same word he would have done so. Next, 'deposit of the river' is not a literal translation of *IM. GÚ. EN. NA*,¹ *EN. NA* being hardly a satisfactory Sumerian equivalent for the latter half of this phrase. I suggest that the idea of 'river mud' comes from the primary meaning 'yeast of *šikanu*'. Certainly neither 'yeast' nor *EN. NA* suggests 'river', and I think we should see in *šikanu* (v. *šikinnu*), from *šakānu* 'deposit', associated with the idea of 'yeast', 'leaven', the dough left over from yesterday for the purpose of providing leaven.² It may be added that a connexion between *IM. GÚ* and *IM. GÚ. EN. NA* is shown by the occurrence of one as the variant of the other (*AM.* 51, 1, 12).

In continuation of the above we can add the instances of *IM. GÚ. EN. NA* in *MT.*: for *head*, almost certainly, *ext.*, *AM.* 7, 3, 2 (+65, 5, 2): poultice, uncertain disease, *AM.* 54, 1, 7, 11: *stomach*, ($\frac{1}{2}$ *ka* in poultice, with others) *Kū.* ii, i, 4: *stomach*, brayed alone in beer, and kneaded, use presumably *ext.*, *AM.* 48, 1, 6: *stomach* (kneaded with gazelle dung, &c., in beer), *AM.* 48, 3, 3: 'middle' (pubes) and *loins* (brayed in beer with others) (*IM. GÚ. EN*), *AM.* 45, 6, 11: for when the *chest* 'is loosed' (*paṭrat*) (varying with *IM. GÚ*), *AM.* 51, 1, 12: for *anus-trouble* (haemorrhoids), *AM.* 58, 2, 3: *KAR.* 201, 11 and r. 15 (apply anus in both cases with others): for *bubul sāmu* 'red pustule', *AM.* 78, 7, 6: for *swelling*, in *kurunnu*-beer with fine-ground flour, *AM.* 79, 1, 14: anoint (the affected place, uncertain) in oil alone with

¹ Cf. [*A. LA*] *L ID. DA* = *šikin nāri*, ii R. 48, 37, e: 'S' 21. For the actual *IM. GÚ. ID. DA* see further.

² *EN. NA* suggests 'time previous', with its meaning *adi* 'until', and perhaps *elā* 'upper'.

IM. GŪ.EN.NA, *AM.* 75, 1, 33: in date-water alone, bind on head, *CT.* xxiii, 50, 10.

With *IM. GŪ* and *IM. GŪ.EN.NA* as meaning 'mud' and 'leaven', we can discuss *IM. GŪ.GAR.RIN.NA*. *GAR.RIN.NA* must surely be the same as *GAR.RIN.RA* (bread, *D.* 597, 387). The *RIN* will represent 'something round', i.e. the *GAR* 'bread' (*NINDA*): the addition of *IM. GŪ* 'leaven' suggests that it is not the flat, circular pancake of unleavened bread, but a loaf, unless we are to accept *GAR.RIN.NA* as the unbaked dough from which the portion to become 'leaven' is removed, a very unlikely suggestion. In *MT.* *IM. GŪ.GAR.RIN.NA* is prescribed: for itch on head, *ext. AM.* 3, 5, 11: uncertain, poultice, *AM.* 23, 8, 4: stomach trouble, *ext.* with gazelle dung, &c., *AM.* 40, 5, 11: uncertain use, *AM.* 43, 2, 7, 9 (see *RA.* 1929, 62): *ext.*, apply to the place, *AM.* 44, 1, ii, 6 (*JSOR.* 1931, 56). Cf. here the uses of *šuršummu*.

The two other expressions, *IM. GŪ.ĪD.DA* 'deposit of the river' (i.e. mud), and *IM. GŪ.A.AB.BA*, 'deposit of the sea' (i.e. tidal mud) need no further discussion.¹

To sum up: *IM. GŪ* has the meaning of both mud, and yeast or leaven, the latter being made definite in *MT.* by the addition of the words 'kept back for a day': *IM. GŪ.GAR.RIN.NA* is leaven of bread (or dough): *IM. GŪ.EN.NA*, properly leaven of dough set aside, also means the (frothy) deposit left behind after floods. *IM. GŪ.BI.TIN.NA* is the yeast from fermented drink, which shows that the Assyrians recognized the similarity of leaven and yeast.²

2 (h) Aklu, isikku, *IM. KAL*, soot, sublimate, esp. chloride of ammonia, sal ammoniac. (Cf. also *ītru*, *īrānu* 1 (j)).

About ten years ago I discussed *IM. KAL* with Professor Nevil Sidgwick, as I thought *IM. KAL.GUG* represented 'mercury', asking

¹ A word is necessary on the possibility of including tartar here: 'the precipitate of the wine which settles in the casks of the winery forms stone-like crusts and is called by the works-people by the name of *tartarum*' (Hoover, *Agricola*, 234). But the use of *IM. GŪ* in bread and the indication 'kept back for a day' point to yeast or leaven as the certain translation.

² Although in *MT.* the obvious translation for *IM. GŪ.EN.NA* is yeast, and not 'mud of the river', it is worth mentioning that cimolite, a cretaceous earth, an aluminous silicate, a white chalk dissolving in water, was used according to Pliny (*NH.* xxxv, 57) for spleen, testes, tumours, swellings, pustules, and feet. *P.* 129 describes cimolite as containing alumina, silica, and ferric oxide, while *creta Gallica* (soapstone) is a silicate of aluminium and magnesium, used in prurigo, and as a dusting powder. There is no lack of cretaceous deposits on the Euphrates or the Tigris (*PC.* xxv, 476). Cf. (?) *saknaj*, a Persian word for a kind of bitumen brought from Syria (Steingass, *Pers. Dict.*, s.v.) which has some similarity of sound with our *šiknu* 'deposit'.

him for his views about *IM.KAL*, which I believed to mean some form of condensation. He instanced *sal ammoniac*, sublimated from the ordinary camel-dung, as a meaning for *IM.KAL*, which will, I think, be seen to fit the instances in *MT.*, where *IM.KAL* is used alone, brayed for the head, the prescription following being for *kuraru*, itch, *AM.* 2, 3, 3, sim. to *KAR.* 202, i, 49 (for which nowadays ammonium chloride is a usual drug). In *AM.* 26, 4, 7, dup. 64, i, 11+37, i, *RA.* 1929, 68, it is prescribed alone for some form of pain, and again I may instance *ammonia* as of use for stings (*P.* 132).¹

But, although we accept *sal ammoniac* as a meaning for *IM.KAL* (at all events in certain cases), it will be obvious, not only from certain syllabaries, but also from the word *IM.KAL.GUG* (if I am right in translating this as 'mercury'), that *IM.KAL* must also have a simpler meaning, besides that of *sal ammoniac*, as it certainly cannot have any reference to *ammonia* in a word for mercury. The probability is that we must see an original meaning 'soot', 'sublimate' in it, out of which has grown the more elaborate (or more careless) meaning *sal ammoniac*, as the commonest form of sublimate known to the Assyrians. In proof of this, consider the literal meaning of *IM.KAL*, the Sumerian suggesting either 'strong' or 'hard' *IM*, i.e. 'tough' (as adhering to the chimney), in which case the actual words describing *sal ammoniac* the sublimation from the soot of camels' dung, in *BMM.* 73 as very tough, and difficult to powder, are indicative. Less probably the *KAL* is here *šarāpu* (?) 'burn' (*D.* 322, 33). Now in *CT.* xix, 2, r. 13, K. 55, *IM.KAL* = *aklu*, and in the dup. *Mat.* 29, rev., iii-iv, 11-13, *IM.KAL* = *ak[lu]*, *aš[tu]*, *i[sikku]*, while K. 55 gives (ll. 14-17) *IM.KAL(AG).GA* = *aštu*, *isikku*, *dannu*, *kuššikku*, for which *Mat.* 16-17, gives *dan[nu]*, and *ku-uš-[šik-ku]*. *SAI.* adds *CT.* xii, 21, 37485 (rev.), which contains the words *dannu*, *aštu*: . . ., and *ak*- . . . in a right-hand column, the remains of *KAL* being visible in the first line of the left-hand column. *Aklu* may well be from the root *ekēlu*, *akālu*, 'be dark', *eklitu* 'darkness' the *a*₃ in *aklu* being paralleled by *ebēru* 'to collect', which gives *abartu*: *a₃bašu* 'to bind' gives *abšu*: and there are the doublets *abartu*, *ebertu*, 'bank'. *Aklu* will, then, be the 'dark (black) thing', like our lamp-black, soot.

But we can go further in our explanation of *IM.KAL* (*IM.KALAG.GA*). As I have tried to show (*PRSM.* 1924, 9 and No. 2(j)), *IM.KAL.GUG* is the solidified vapour of cinnabar (the 'red' substance), in other words, the sublimate, a meaning which will be seen to be supported by the equation *IM.KAL* = *isikku*. This latter can be no other than the Syr. *assākā*, *sublimatio* (in spite of the variation between *k* and *ḵ*), with a

¹ See *PRSM.* 1924, 9: *AṣSL.* 1930, 16. The fact that there are other words for *sal ammoniac*, *iṣru* and *iṣrānu*, need not prevent our present identification.

verb *assek*, sublimavit.¹ This settles 'sublimation' as the equivalence for *IM.KAL*.²

2 (i) *IM.KAL.LA* 'sublimate of scrapings', *sal ammoniac*.

(See also *iṭru*, *iṭrānu*, No. 1 (j)).

With the probability that *IM.KAL.GUG* is mercury (No. 2 (j)), and that *IM.KAL* is 'sublimate', with a derived meaning *sal ammoniac*, we can now consider *IM.KAL.LA*, 'the sublimate of *LA*'. *LA*, *ḥašbu*, has generally been accepted as 'potsherd' e.g., *CT*. xvii, 35, 63, *kima ḥašbi* (*LA.GIM*) *liparrirūšu* 'like pot(sherds) may they break him'. *Nanšabu ša LA* is 'pipe of *LA*' (contrasted with those of wood and reed, Meissner, *MDAG*. 1925, 1, 2, 36). But it certainly means much more than mere potsherds. The syllabaries show the equivalences: (*CT*. xii, 8, ii, 2) *ŠI.KA:LA* (*la-lu-u*) = *ḥa-aš-bi*, *epiru ḥi-il-su*; (*ib.* 14, 13) (*KU.UD*) *KUD* = *ša LA.KUD.DA epiru* [*ḥi-il-s*]u; *CT*. xix, 1, (*K*. 55, obv. 17) [*LA* = *ḥa*]-*aš-bu*. *LA.KUD.DA: epiru ḥi-il-su*.³

The specialized group *LA.KUD.DA* occurs in omens (Gadd, *CT*. xxxviii, 8, 32 ff.: Nötscher, *Orientalia*, 1928, 70, 31 ff.) 'If *LA.KUD.DA*^{pl} *ina sūki DU.DU u purruka*, lie in the road and block (it)' (like the corpses in *Asb.*, v *R*. iv, 82, *ša sūké^{pl} purruku malū ribāti*): 'if *LA*^{pl} *ina sūki* ditto *u šušura*, lie in the road and allow passage'. Cf. *LA* 'standing at the four crossroads' in a ritual for a woman with some trouble in menstruation (*KAR*. 194, 1, 9), and *LA labira (ra) ša ki-ib-d [a (?)]* . . . (*AM*. 13, 3, 3, 'old *LA* which . . .'). 'If a river brings water *kašamāmutu*, and therein *LA.KUD.DA ana kibri ištanaḥḥit*, leaps of itself to the bank' (probably 'floats') (paralleled by *^aPEŠ₄^{pl}*, geodes, hollow haematite, No. 10 (*a*), which can doubtless float, owing to their air chamber) (*CT*. xxxix, 58 and 57).

Epiru ḥiḥsu, 'ḥiḥsu-dust', and not the strange form *išḥiḥsu*⁴ must be the correct reading. This is clear from the meaning of *ḥalāšu* in the prescription in *CT*. xxiii, 34, 34, 36: (after reducing certain drugs in fire to ashes

¹ Both hitherto assumed to be from the Syr. root *s'lek* (Brockelmann, *Lexicon*).

² The reading *kuššikku* is certain from the variant *ku-uš*. . . . There are additional equivalents *AN.NA* (= 'upper') (*K*. 55, 18), *IM.TĀK* (= 'clay+stone') and *IM.TĀK.AN.NA* (= 'clay+stone+upper') (*K*. 55, 19: *Mat. ib.*, 17, 18), i.e. the soot from the upper part of the furnace. I can find no Semitic equivalent for *kuššikku*.

³ Another Sumerian equivalence for *LA.KUD.DA* is . . . *SA*, and the Sumerian line below this, also . . . *SA* = *ma-ak-da-du* (*CT*. xix, 1, *K*. 55, 18, 19). The line following (20) is *zi-e pa-ḥa-ri* 'dross of the potter', i.e. from his furnace.

⁴ As against Meissner (*MDAG*. 1925, 1, 236). *Ḥalāšu* must surely mean 'scrape, skim', the Heb. *ḥālaš* meaning 'draw off, withdraw (shoe)', *ḥālišāh*, 'what is stripped off' as plunder: Syr. *ḥallaš* (Pael) 'despoil': Arab. *ḥalaša* (II) 'purified, separated'. This is to be explained by the ordinary word in Assyrian for 'purified oil' (i.e. including olive oil), *šamnu ḥaḥsu*, the olive oil rising to the surface of the vats and then being skimmed off.

and mixing them in oil) 'recite the incantation seven times, anoint him (*tapassas-su*) three times': 3-*šu taḥall[as]u enuma taḥallaṣu-šu šipta 3-šu ana eli kaḫḫadi-šu tamannu (nu)* 'three times thou shalt scrape him; after thou hast scraped him, thou shalt recite the incantation three times over his head'. No other explanation seems possible, the oil having been put on the man three times and as many times presumably scraped off.

This second explanation 'scraped dust', *epiru ḫišu* for *LA* and *LA.KUD.DA* compels us to consider the *LA* in *IM.KAL.LA* as having two possible meanings. *LA* by itself is definitely a product of the furnaces, as is clear from the following examples: $\frac{1}{3}$ *ka LA.IM.ŠU.RIN.NA* ('one-third of a *ka* of *LA* of an oven') with others steep in rose-water, bind on (for dryness (?) of the head, &c.), *CT.* xxiii, 23, 8: with *ZID.ḲU* (fine ground flour) steep in rose-water and bind on his head (*ib.* 31, 64): note particularly *LA.BUGIN.BAD* 'LA from an old oven' (to steep in rose-water with lolium and gypsum, to bind on head, *KAR.* 202, 1, 12, in comparison with *ḫeṣpā d'tannūrā 'attīkā* of *SM.* ii, 187, for gangrene of the mouth, i.e. 'ḫeṣpā of an old oven'). We have thus two possibilities for the meaning of *IM.KAL.LA*: the first, that it is the result of the first sublimation or calcining of dung in a fire which will give the soot containing *sal ammoniac*: or, more probably, it is the result of the second heating of the soot of dung-fires, which is the usual method of producing the salt, which sublimes to the top by this process (*EC.* 146. For a description of the method see 1 (j)). In continuation of this, cf. *iṭru* (No. 1 (j)), a word comprising various salts, including the soot from which *sal ammoniac* is made, which is to be calcined (*taḫallu*, p. 13) as a drug; that is to say, in *iṭru* we have a word for the simple soot of the dung-fire containing the ammonia, not properly sublimated into a salt, a further process indicated by the directions in *taḫallu*. That is, we may be able to differentiate our *IM.KAL.LA* as the scientific 'sublimate of scrapings of the furnace' (i.e. after a second calcination) from *iṭru*, the simple soot. What difference (if any) exists between *IM.KAL* and *IM.KAL.LA* is not easy to settle. *IM.KAL*, as 'the sublimate', might well have stood for the *sal ammoniac* from the common fuel in careless parlance: or, it is conceivable that *IM.KAL* means the simple soot, and *IM.KAL.LA* the *sal ammoniac* after the second calcination.

IM.KAL.LA is also used as a paint on figures of clay and tamarisk (*KAR.* 298, 41, 47, and r. 8: Smith, *JRAS.* 1926, 696 ff.). The colour I presume, will be a grey ashen tint, as *EC.* 146 describes the solid cake of salt of *sal ammoniac* as of greyish colour, and in the Assyrian text the other colours provided for (*JRAS.* 1926, 696, 4 ff.) are red, white (plaster), white with black streaks, black, green (or yellow) and mercury (silver?). *IM.KAL.LA* is not included in Gadd, *Forms and Colours* (*RA.* 1922, 10).

In *MT. IM.KAL.LA* is prescribed brayed and drunk alone in cedar oil and beer for *jaundice*, *Kü.* iii, iii, 13 (*Kü.* 'Kalk'): similarly in oil and beer, *ib.* iv, 40. These two passages are most important for its meaning: ammonium chloride is a hepatic stimulant used for jaundice to-day (*P.* 144, 1353). Again, *IM.KAL.LA* in *AM.* 36, 1, r. 2 is used in some way for *ears*, the end of the prescription (whatever other drugs may be used) being to fumigate them, and in *P.* 145 the modern use of the vapour of *amm. chl.* is for inhalation in nasopharyngeal and eustachian catarrh. For some trouble in *menstruation* *IM.KAL.LA* with two forms of arsenic and alum are to be drunk in beer, *KAR.* 194, iv, 3. In *P.* 1348 *ammon. acetat. liquor* is prescribed for dysmenorrhoea. These four instances seem to coincide so well that we need have no doubt that *IM.KAL.LA*, standing for 'sublimate of scrapings' means the condensed ammonia, ultimately obtained from the dung fuel, and, as we saw above, simple *IM.KAL* was shown to have a similar meaning.

The other uses of *LA* will follow easily: *LA* of pomegranate for jaundice in *eyes*, *AM.* 12, 6, 8: to be burnt and applied to *swelling*, 74, 1, 16: to be brayed (and applied) to remove *umsati*, 17, 5, 9: brayed alone for application to *kappaltu*, 74, 1, 21: dry (*UD-a*), bray and apply to outbreak on foot: uncertain, 66, 6, 8. This must be the rind or pericarp of the pomegranate, as I pointed out in *AH.* 279, and what is important to note is that it is not the ash, but the actual rind, which is to be dried or burnt. The rind is much valued for its astringent properties (*PC.* xix, 129: *SM.*, Index, s.v.) and, as any one who knows the Eastern bazars will remember, it is constantly displayed broken up in the shops. *LA pili GA.ŠIR.ĦU* 'ostrich egg-shell'¹ (for *pili* 'egg' see Thureau-Dangin, *Rit. Acc.*, 84) is drunk with black saltpetre and pine gum for kidneys, *AM.* 39, 6, 9: drunk with others for kidneys, 39, 9, 3: drunk, usually after being brayed, for strangury, 59, 1, 15, 16, 26, 34, 41: 60, 1, 7, 9, 19: drunk, for urinary trouble, 58, 4, 11: applied, in strangury, 60, 1, 5: pounded and anointed on head, *KAR.* 202, ii, 16. Again the braying indicates that we have not an ash here, although no actual word for burning is ever applied, as in the pomegranate: *IB.* 392 recommends ostrich egg-shell pulverized as it is, without burning, for pleurisy.

The *LA* (shell) of a crab (see *ĴRAS.* 1929, 804) is to be heated in an oven with others with red urine and mixed in oil and beer to wash the patient, *AM.* 94, 2, r. 9: and here again we must surely see the shell and not the ash of it. Consider also the following: *Ḥaṣabtu* follows *ḥaṣbu* (in the value of the latter for *LA*) as meaning 'scrapings of the roads': *ana tili ḥaṣbāti* 'to dung heaps' . . . ii *R.*, 60, d, 17. Cf. Smith, *DB.*, s.v.

¹ To Ungnad must be given the credit of seeing that *GA.ŠIR.ĦU* was the ostrich (*Deutsche Literaturz.* 1922, 198), my (independent) identification having appeared subsequently in *AH.* 279 in 1924.

Dung, i, 460 (of the O.T.) . . . 'the sweepings of the streets and roads which were carefully removed from about the houses and collected in heaps outside the walls of the towns at fixed spots'. In Mesopotamia, of course, the dung is always collected and made into cakes for fuel. From this meaning 'dung' for *ḥaṣabti*¹ we can go on to see the explanation of *ḥaṣabti nâri*, obviously a transferred meaning, exactly the same as *A. GAR. GAR. nâri* 'dung of the river', i.e. bitumen: (*AM.* 85, 1, 10) 'When a man is bewitched, *ḥaṣabti nâri u ku-up-ra*, dung of the river and pitch (boil), add *kurunnu*-beer, drink on the day of the moon's disappearance before the sun, and say "O witch, thy sorcery shall recoil on thee and seize thee!"' As there is no known Semitic equivalent for *A. GAR. GAR. AN. ÎD*, 'dung of the river', surely *ḥaṣabti nâri* fills the blank well? Simple *ḥaṣabti* is prescribed with eight other drugs to be brayed and applied to the head for *samânu* (ringworm) (i.e. ammonia) (*AM.* 1, 2, 15). 'Dried dung' would explain the use of *ḥaṣabti* with *dukḫuku* ('powdering small') in the similes of a conqueror destroying towns (*MA. s.v.*). Particularly noticeable is *KAR.* 189, ii, 6, *Enuma* ditto *ḥaṣabti ša ina sîḫi nadat(at)* 'If ditto, dung which lies in the street . . .' (also an invocation against witches),² parallel to *LA* lying in the street above. It is not so clear in '5 še *LA* "UD", 'five grains of ash of styrax' to be applied in *himetu*-ghee for eyes (*AM.* 92, 8, 8). Here the ash is undoubtedly meant to be used: cf. Lane, *Mod. Egyptians*, i, 61, where he says that in Egypt *kohl* is a soot produced by burning either a kind of frankincense or the shells of almonds, either of which certainly suggests the resultant soot of the *LA* of styrax.

LA. GUL. GUL amelûti, 'LA of human skull', can be reduced and brayed (*AM.* 15, 3, r. 10), or used in fumigation (*AM.* 99, 3, 5), i.e. the bone of the skull, which can be subsequently 'reduced', or burnt to make a smell. (But it may be simply 'bînu, *JRAS.* 1924, 456.)

Finally, are we to read *lûpû LA ṭābtu* 'fat, scrapings (of?), salt' for eyes, *AM.* 18, 10, 7?

LA, ḥaṣbu (ḥaṣpu?) coincides exactly with the Syr. *ḥeṣpâ*, potsherd, (brain)-pan, (crab)-shell, valve of shell, *testae sepiae*, and even broken glass (Payne Smith, *Thes.*, s.v.: J. S. Margoliouth, *Suppt.*, s.v.). *Qadmîa ḥeṣpânîthâ* (*HS.* ii, text, 44, 17) is obviously the cadmia scraped from the sides of the furnaces (tutty).

To sum up; *IM. KAL* is the scientific term for 'sublimate', sometimes used as an equivalent for *sal ammoniac* in some form (either as the simple soot, or the sublimate after a second calcination): *LA* is the exact equivalence (in its values *ḥaṣbu*, *ḥaṣpu*, and *epîru ḥîlṣu*, 'scraped dust') of the

¹ I was wrong in *AJS.* 1930, 14 in seeing 'pebbles', Arab. *ḥaṣab*, in this.

² The Talmud has something reminiscent (*Pesâchîm*, fol. 110, Cols. i, ii, quoted Hershon, *Talmudic Misc.*, 230) that when a man meets witches he should say 'may a potsherd of boiling dung be stuffed in your mouths, you ugly witches'.

Syr. *ḥesḥā*, meaning crusts, scrapings (esp. of the road and the furnace), rind, bone of skull, &c., and especially used in *IM.KAL.LA*, *sal ammoniac*, as the scrapings of the furnace of dung-fuel containing the ammonia. The value 'sublimate' for *IM.KAL* will be obvious also from the next section, *IM.KAL.GUG*, mercury.

2 (j) *IM.KAL.GUG*, 'sublimate of the red (= cinnabar)', mercury.

IM.KAL.GUG 'mercury' (*PRSM.* 1924, 9) is made up of *IM.KAL* ('sublimate') + *GUG* (*sāndu*) (not 'red stone', be it noted), doubtless borrowed by the Greeks in their *σάνδυξ*, minium (see 14 (a)). Pliny (*NH.* xxxiii, 37 ff.) says that minium (our cinnabar, Bostock, *ib.*) was found in Carmanian silver mines. Nowadays it comes from Kerkuk Baba (*A.* 243), and the Afshar district of Kurdistan, the Zarshuran mines there showing plentiful traces of ancient mining (Mactear, *TIM.* iii, 1894, 16). Pliny describes the making of hydrargyros from the 'inferior' minium, either by pounding minium with vinegar, or by putting minium into flat earthen pans covered with a lid, and then enclosed in an iron seething pot, well luted with clay, after which a fire was lighted underneath, and then the steam which adhered to the lid was removed, being like silver in colour, and water in fluidity. *Diosc.* v, 110, is similar, and Theophrastus, earlier than these, tells how mercury was obtained from native cinnabar rubbed with vinegar in a brass mortar with a brass pestle (cv). The former method, judging from the word *IM.KAL* 'sublimate', must have been employed by the Assyrians.

In *MT.* *IM.KAL.GUG* corresponds to the use of mercury satisfactorily: for *eyes*, *AM.* 11, 2, 12 (bray, apply): 14, 3, 2, and perhaps 50, 1, 4 (see *PRSM.* 1926, 31, 47): in *P.* 618, 620, the yellow and red mercuric oxide ointments are prescribed for various forms of ophthalmia. For fumigations in *ears*, *AM.* 33, 1, 31, dup. *AM.* 35, 1, 7, *AM.* 38, 2, r. 10, and *KAR.* 202, iv, 33: *AM.* 34, 5, 7: *KAR.* 202, iv, 15 (see *JRAS.* 1931, 5, 10): cinnabar is of some use in making fumigations (Pomet, *HD.* 327: cf. the use of chloride of mercury, *P.* 626): *IM.KAL.GUG* is also inserted in ears, *KAR.* 202, iv, 18. As ecboic in difficult labour, alone, to be brayed and drunk in beer, *AM.* 67, 1, iv, 22, dup. *KAR.* 196, iv, 29 (and perhaps *LK.*, No. 55). In *P.* 1338, under the heading 'Ecboics', are 'drastic purgatives', among which mercury may be included. In *AM.* 39, 2, 4 + 45, 7, 6, *PRSM.* 1926, 64, *IM.KAL.GUG* is to be drunk apparently alone in oil and beer, for some (mutilated) form of stomach trouble, with foetor (some form of biliousness?). It is prescribed for a cough, with others (use uncertain), *AM.* 80, 1, 19 (mercury subchloride is used to-day for catarrhal jaundice and chronic pharyngitis, *P.* 626). It is curiously used in a prescription containing 51 drugs against sorcery, *AM.* 87, 7, 7.

IM.KAL.GUG is used to colour small figures (see 2 (i)). It varies curiously with *IM.KAL.KUKKU* for use with the 'LAL-plant (a dye?) (2 (k)).

There is no reason to suppose that the Assyrians were not aware of mercury. They lived within easy reach of cinnabar at Kerkuk, whence it must have been obtained at early times. The words *IM.KAL*, 'sublimate', of *GUG*, 'the red', are sufficiently indicative, and the uses in medicine are fairly so. The period at which it was first employed is not certain, since this must depend on the Ashur tablets which are of varying date, but it may certainly be said to have been in use in the reign of Asb. (668-626 B.C.) and probably two or three centuries earlier.

2 (k) *IM.KAL.KUKKU*, doubtful.

This word varies in the series of duplicates (the 'Chemist's *Vade Mecum*', *JRAS.* 1934, 771), with *IM.KAL.GUG*, mercury, and must therefore be held to be doubtful. The passages are:

CT. xiv, 10, i, 3, 4: Meek, *RA.* 1920, 181, S. 1701, 45, 46: *Mat.*, 88, i, 41, 42:

^u*LAL* | *ina ka-lu-u*

^u*LAL* | *ina IM.KAL.KUKKU* (i.e., *Br. No.* 3343 repeated)

CT. xiv, 44, i, 14, 15:

^u*LAL* (?) *ku-la-lum* | *ina ka-lu-u*

^u*LAL* (?) *ku-la-lum* | *ina IM.KAL.GUG* (re-exd., practically certain).

On *Mat.* 88 the word is *KAL.KUKKU*, not *IM.KAL.KUKKU*, so that we have here three possibilities for one word. The difficult variant for ^u*LAL* reads . . . *ku-la-lum* preceded by the remains of one character, half a horizontal wedge written higher than the middle of the line, with the possibility of a vertical preceding it, there being room for nothing more, if the ^u is supplied at the beginning, so that *LAL* seems the only likely sign, followed by some epithet.

^u*LAL* is a very difficult plant to identify. It was taken as booty with ^u*šisanu* a reed (or water plant?) and dyed cloth by Tiglath Pileser III from Merodachbaladan on the Sea-coast (Persian Gulf) (ii, *R.* 67, 28). In a prescription preceding one for when 'sickness comes forth on a man's body', a salve contains both ^u*LAL* and *šamma* ^u*LAL* together, which suggests rather (as I thought in *AH.* xxi) that ^u*LAL* has some special characteristic such as a dye, besides its intrinsic value as a drug (*AM.* 52, 3, 9). In a salve, *AM.* 93, 1, 2 and 7: 96, 4, 6: 97, 4, 15: uncertain, probably salve, 87, 5, 15: fumigate, 91, 1, 9. *Kū.* iii, iv, 14 mentions it alongside ^u*DIR* (the 'red drug'), for some form of jaundice. It is frequently combined with *KA.A.AB.BA* (kelp?) in these prescriptions.

In *BRP.* 32, 18 (*JRAS.* 1924, 456) ^u*LAL* is explained as *kima* ^u*hašhūri ina nīrib tamtim ašar šammu u GIŠ.GI la bašū ina pān mē^{pl} ušū*

ina muhhišu . . . 'like an apple (or oak-gall?) near the sea where grass and reed are not, it comes forth on (at the face of) the water, in front of it. . . '

Now this definition must surely refer to a plant growing by the sea, probably a sea-weed: the fact, too, that Tiglath Pileser took it as booty indicates a practical value. This again suggests one of the dyes from sea-weed, such as Pliny's *phycos thalassion* (*NH.* xxvi, 66), which 'resembles the lettuce in appearance, and is used as the basis in dyeing tissues with the purple of the murex . . . it is efficacious as a topical application not only for gout, but for all diseases of the joints'. One kind was used in Crete for dyeing cloths. In Syr. the *sumākthā*, fucus, alga, means 'the red'. Alga of this kind occurs as a dye in the Leiden Papyrus X (c. 3rd cent. A.D.) (*Coll.* 48) with the Phrygian stone, a kind of alunite, and also in Democritus (*ib.* 44). Beckmann (*HI.* i, 35) considers the 'sea-weed' of Pliny not a sea-weed, but a lichen growing on the rocks, such as is still collected in the Greek Islands, and this Roccella, when old, has its stems crowned with a button ('like an apple?'). Rawson, however (*DD.* s.v.) gives algine as a dye from sea-weed.

^u*LAL*, as a parallel to ^u*LĀL*, safflower, might conceivably be another red dye-plant, the *rubia tinctorum* or madder, exported in large quantities from Bushire (100,000 Tabriz maunds, Pelly, *Trans. Bomb. Geog. Soc.* xvi, 1860, 46: cf. Wellstead, *Roy. Geogr. Soc.* vii, 1837, 103, as an export of Muscat). But madder is hardly to be accounted as especially growing by the sea, and as a drug it is used chiefly internally, of which we have no indication in *MT.* for ^u*LAL*.

However that may be, we have next to seek the use of *kalû* (yellow ochre) and the doubtful word *IM.KAL.GUG* (mercury), *IM.KAL.KUKKU* ('the sweet sublimate'), or *KAL.KUKKU*, uncertain, in connexion with ^u*LAL*.

None of these are outstanding as of use in dyeing. If *IM.KAL.KUKKU* were really the word here, the 'sweetness' would suggest 'sugar of lead', lead acetate, but the acetate is not formed by sublimating, and it is not the acetate of lead which is so useful in dyeing, but the acetate of tin. *EC.* 771 speaks of the ease of adulterating madder with red and yellow ochre, but I have no reference for the same done with an algine dye, nor have we red ochre (*IM.MAL.LI.GUG*, not *IM.KAL.GUG*) in the cuneiform text in question. Mercury would, I presume, be useless in dyeing, besides being probably very expensive and troublesome to use in order to obtain a simple red dye.

2 (l) *Kalû*, *IM.MAL.LI*, yellow ochre.

2 (m) *Kalgugu* (*kalgukku*, *kalgukku*) *IM.MAL.LI.GUG*, red ochre (obtained by heating yellow ochre).

'S' 13, 14: *CT.* xviii, 34, i-ii, 10. Earth, which being first *IM.MAL.LI*, becomes *IM.MAL.LI.GUG* 'red *IM.MAL.LI*'.

In *PRSM.* 1926, 53, I suggested that *kalū* was yellow ochre, and this would lead us to red ochre for *kalgugu*, the ordinary yellow ochre becoming red by burning. 'The yellow and red Oker is one and the same thing, for the natural Colour is yellow, and it is turn'd red by Means of a reverberating Furnace' (Pomet, *HD.* 416). Lemery (*ib.* 417) says of yellow ochre 'they calcine it in the fire 'till it gains a red colour, and then it is call'd Red Oker'. We can follow this up first by showing that *kalū* is yellow.

In *BBR.* 50, 5, among certain mythological figures a male and a female are to be painted with this *kalū*, which may thus be flesh-colour. The Sumerians regarded a kind of yellow as the colour of the face, judging by the colouring on the face discovered by M. Watelin at Kish, which may be described as a pale reddish yellow, without the addition of red on the cheeks (Langdon, *Ill. Lond. News*, Feb. 8, 1930, 206). Moreover in 'S' 12 *IM. GUSKIN* = *illur pāni* and *illurū* (?), preceding *kalū*, and, still more important, in 'T' 32 *IM. GUSKIN* = *illur pāni* = *ka-lu-[u]*: that is to say 'gold-clay' which is 'face colour' is the same as *kalū*. We may therefore accept the meaning of *IM. MAL.LI* as a yellow clay, probably an ochre. (Cf. also p. 19.) This is borne out in an amusing fashion in the *Lamaštu*-texts (Myhrman, *ZA.* xvi, 170, 38) in the description of the daughter of Anu in . . . *ka-li-e TE* (= *lit*) -*sa arkat*, 'the *kalū* of her cheek has gone greenish-yellow'. The latter colour is still used by the modern Arab to represent the paleness or greenness of terror. It must not be forgotten that the olive skin of the Mesopotamian is not ruddy like the Western, or for that matter, the Persian of the Highlands. It is used (*ib.* 174) to paint figures of dogs: *kalbē ina gašši u ka* (?) -*li-e tu-ka* (?) . . . 'dogs with gypsum (white) and yellow ochre thou shalt . . .'. Cf. the Bab. contract: 'for 10 shekels of silver, wax: for 2½ shekels . . . *IM. ga-li-[e?]*, and for 3 shekels of silver, cedar (-wood?) for the work of Bêl' (*NB.* 201), suggesting a yellow colour (and, with the wax, a polish for the cedar?). In *MT.* ('If his right eye, if his left eye, if his eyes *IM. MAL.LI RU-at* (*RU^{pl}*) deposit *kalū*') it must mean a yellow pus (*AM.* 75, 2, 8-10). Drink,¹ with fifteen others for strangury, *AM.* 31, 1, 5+59, 1, top.

Kalgugu, *kalgukku*, the red form of *kalū*, does not occur in *MT.*, but is quoted twice in the Glass-texts: 'Thou shalt mix together . . . of [*k*] *algugu*, one shekel of *IN. NU. [UŠ]* (tragacanth gum): this is *tu- . . .*' (*OTC.*, Sect. LL). This is either a colour to be applied to pots, probably after they have been fired, or still more probably, it is a red paint (rouge?), the tragacanth in either case being an adhesive. It is important to compare the Egyptian face-rouge noted by Lucas (*AEMI.* 85) which

¹ Compare the steatite earth eaten in Mosul, a silicate of magnesia and alumina (*Tr.* ii, 127): Rich (*Koord.* 29) speaks of an earth used to give an acid flavour to dishes, while in India (*CPI.* 329) *jusabar* is an earth eaten by women.

is a natural red oxide of iron, while burnt yellow ochre is actually used for paint during the XIIth Dynasty (*ib.* 289). Sect. X, Appendix I, mentions *zuku*-glass with *kalgugu* and saltpetre. *Kalgugu* as a cheap paint is to be seen in *KAVI*. 98 (cf. Ebeling, *MDAG*. VII, 1, 11), one of a series of early Assyrian letters (from the beginning of the first millennium?) giving instructions about some wooden *umminate* boxes, which are to be taken out of the storehouse (*bīt nakanta*) as well as twenty mana (about twenty pounds) of *kalguḳa* and twenty mana of *ka* (?) - *lak* (?) - *ku-ta*, followed apparently by cypress (-gum) (. . . *im-di*, 1. 32) from the 'House of gums (aromatics)'. Here the *kalguḳa* and *kalakkuta* (?) are evidently paints for the *umminate*, and the cypress-gum is either for varnish or as an adhesive.¹

I cannot identify *kalū* with a Semitic root, but *kalgukku* may be the Syr. *k'lūk* (a kind of red earth): for the lost palatal, cf. Mar'ash (Mar-kaši), Jerabis (Carchemish).

To sum up: *IM.MAL.LI*, *kalū*, is a flesh-coloured clay, yellow ochre, which becomes *IM.MAL.LI.GUG*, *kalgugu*, red ochre produced by burning the yellow.²

2 (n) *ḡabū*, *IM.SAḤAR.TĀK.KUR.RA*, alum.

Cf. here *IM.SAḤAR.PAR.KUR.RA*, and *IM.SAḤAR.GĠG.KUR.RA*, white and black *IM.SAḤAR*.³ In *KAR*. 202, iv, 29 *IM.SAḤAR.TĀK.KUR.RA* is divided between two lines.

IM.SAḤAR.TĀK.KUR.RA = *ḡga-bi-i*, *KAR*. 42, r. 10-11: forms like *ḡgab-ū* (*BRP*. No. 32, 22) occur. Thureau-Dangin shows that this is alum (*RA*. 1920, 27), used by cloth merchants (for dyeing) (*Nbk*. 392: *Nbn*. 214: 751: 794: 938: 1061: *Camb*. 156) (alum is, of course, a common mordant): particularly with *šibū* (indicating dyeing) (cf. *Nbn*. 214, 6: *Camb*. 156, 3): in *Nbk*. 392 a maker of coloured cloth (*amūšpar būmu*) receives a sum of money for *gabū* for dyeing purple. Sometimes the *ḡgabū* of Egypt is mentioned (*Nbn*. 751, 7-8: Pinches, *ZK*. 2, 32: Ebeling, *NB*. 21: *gabbū*, *Nbn*. 214, 3), which, according to Pliny (*NH*. xxxv, 52) was the most esteemed. Thureau-Dangin quotes (*l.c.* 28) a contract for . . . manas of *ḡgabbū* (alum) and . . . manas of

¹ Ebeling (*ib.*) suggests that *kalakkuta* is *KAL(AG)*. If it were *IM.KAL*, soot (No. 2(h)) we might see a black paint, but there is no evidence for this at all.

² It is hardly likely that the place-name Kerkuk (near which is a plain of red saliferous sands, *A*. 241) can be philologically connected with *kalgugu* (which has, of course, nothing to do with *IM.KAL.GUG* 'mercury'). Kerkuk Baba, the place of the petroleum fires, means in Turkish 'father of boiling', and, although a corruption of an old name to an intelligible modern meaning is possible, it is not likely.

³ *IM.SAḤAR*, split into its components *IM* 'clay' and *SAḤAR* 'dust', suggests an adhesive but flaky substance, in other words, a shale, since alum is obtainable from shale.

pagratum (galls), $\frac{1}{3}$ ka of oil, $\frac{1}{3}$ mana 2 shekels of myrrh *ana risittum* (for tanning?) to a leather worker (*Camb.* 155), and gives the Assyrian method of tanning from K. 4994 (iv. R. 28, 3) and VAT. 9722 (*KAR.* No. 29): 'Kidskin thou shalt feed with milk of a yellow goat and with flour: anoint with pure oil, oil, fat of a pure cow: thou shalt dilute alum in pressed grape juice, then fill the surface of the skin with gall-nuts of Ḫatti tree-cultivators';¹ and (*KAR.* 60, r. 5) 'this skin thou shalt take and in ground flour of pure wheat in water, beer, and wine of the best quality thou shalt steep. With the best *ḫimetu*-ghee of a clean ox thou shalt press the alum of Ḫatti and gall-nuts, and cover the bronze drum' (i.e., with the parchment). For a skin of *urīšu rabū* ('great kid') of Nanâ three mana of alum are provided (*HRET.* No. 128, Nabopolassar). In 'R' 28-31 *akamun bīni* and *asahma* are the equivalents of *agabū*, alum, the black kind being defined as *lurpadu* and *annuhara*. In 'M' 21 and 'S' 5 it is the black kind (*IM.SAḪAR.GIG.KUR.RA*) which is *sahmu* (*sahmi*) while in 'S' 4, the white kind (*IM.SAḪAR.PAR.KUR.RA*) is *anuharu*. (For 'male red alum' v. *Introd.* § 8 (H).)

(a) *akamun bīni* (the *akamun bīni* of CT. xiv, 44, i-ii, 13, and the *kamun bīni* of Meek, *RA.* 1920, S. 1701, i-ii, 5; and the [TIN]. *TIR. ŠAR GIŠ* (?) *ŠINIG* of *Mat.* 88, i, 40), to be used *ina agabū*, in alum, (*JRAS.* 1934, 776) is the lichen from the tamarisk, perhaps cudbear, as a dye, mordanted in alum. But, from above, *akamun bīni* has also the meaning itself of 'alum', doubtless an alchemists' synonym: and this will give us the clue to the explanation (*JRAS.* 1924, 456, 22) . . . *išid bīni uššū(u) šaniš kamun bīni: agabū: agabū: . . .* [*kamun bīni* is a substance which] comes forth on the root of a tamarisk, or alternatively, *kamun bīni* is alum. Alum is . . . Here we have the double explanation of its meaning, which will allow us to see both 'lichen' and 'alum' in it, the latter being a professional trick of the chemists to conceal their meaning.

(b) *Sahmu*, since we cannot be sure whether it is the white or black alum, cannot be referred to the Syr. *sahmā* 'black'.

(c) *annuhara* (included in *AH.* as a plant) in *MT.* is once defined as a stone, *annuhara*, used in some form of beer when saliva comes (too) plentifully in the mouth, *AM.* 31, 4, 12. *Without det.*, against *sorcery*, *AM.* 89, 1, ii, 13: against *sorcery*, to eat (*ikal*), green (or yellow, *aruktu*), with green tragacanth, &c., *AM.* 85, 1, ii, 15 (cf. a): for *bruise* or sim. (*KI mišitti*) (ext.?) *AM.* 76, 2, 11: for *ḪAR^p*, the mouth having foetor, bind on in poultice, *AM.* 55, 1, 7: one shekel, probably for pain in breast, &c., *AM.* 49, 4, 21: uncertain determinative, *AM.* 48, 2, 15: 68, 5, 3.

(d) *lurpadu* = 'black alum', 'R.' 30.

¹ The gall-nuts of Ḫatti are paralleled by the alum of Ḫatti, *KAR.* 60, r. 7, *IM.SAḪAR.TĀK.KUR.RA ša mātu Ḫatti*.

(e) For *ṭābtī šikkati* see *ḡaltu*, No. 58.

In *MT. ḡabū*, *IM.SAḤAR.TĀK.KUR.RA* is prescribed: for eyes, with *styrax and *EME.ŠAL.LIM* salt, *AM.* 16, 1, 10, dup. *KAR.* 183, 9: with others, *AM.* 9, 1, 34: 10, 4, 6: 15, 6, 8: 16, 1, 8: for ears, after sprinkling one shekel of pomegranate juice, and one shekel of water of pine turpentine on wool and putting in ears, bray alum and blow into ears, *KAR.* 202, 4, 29, dup. *AM.* 34, 1, 29 (cf. 34, 5, 9, and 35, 2, 5): blow into ears alone, *KAR.* 202, 4, 15: fumigate ears with others, *AM.* 33, 1, 36: for mouth, to cleanse, *AM.* 23, 1, 12, 13: 25, 6, 1, 7: ii, 10: with *mint, *AM.* 28, 7, 12: with myrrh, *AM.* 21, 4, 5: with *ammi in honey, *AM.* 54, 3, 10: with *styrax, *AM.* 54, 3, 9 (cf. 5): for teeth, to cleanse, with others, *KAR.* 203, 1, 16: on tooth, or mouth, alone apply, *AM.* 36, 2, 9: on tooth or mouth, with others, *AM.* 36, 2, 3: for too much saliva, *AM.* 29, 5, 18: for head, for itch (*ikkitu*) to bind on with others, *KAR.* 202, ii, 6: for *bu'šanū* (smell), *AM.* 27, 1, 3: for head (?), with chamomile in cedar oil, *AM.* 5, 1, 4: for stomach, to remove 'fire' (*siriḫti BIL libbi*, and *BIL libbi*), presumably drink, *AM.* 39, 1, 36: 40, 1, 47: drink (read *NAK*?) in beer, *Kū.* ii, iv, 29: for urinary trouble, with many others, drink, *AM.* 58, 4, 7: drink, *KAR.* 193, 7: alone in beer, drink, *AM.* 59, 1, 24, or alone in water, Lutz, *AṣSL.* xxxvi, 80, obv. 1: as poultice with sixteen others for retention (*himiḫti*), *AM.* 60, 1, 5 (cf. 11, 13, drink (?)). Important is the injection into the urethra (*mušinnu*) for 'when [a man's] semen goes, and he is unconscious of it', &c., *AM.* 61, 1, 10: alone (?) for strangury, to be poured into the penis with oil and *kurunnu*-beer, *AM.* 59, 1, 12. As *enema*, with many others, *AM.* 43, 1, 8: to stay (?) menses, drink with *IM.SIG₇.SIG₇* (orpiment), *IM.GUŠKIN* (realgar), and *IM.KAL.LA* (mercury) *KAR.* 194, iv, 3: as ointment, two shekels of *ḡabū*, two shekels of *nitru* (carbonate of soda), two shekels of sulphur, pounded and strained in almond oil, *KAR.* 198, 10: with many others in oil, *AM.* 4, 6, 9, dup. 96, 4, 1: ext., with (?) honey, *AM.* 16, 5, 7 (*ana lib mursi tašakan*, 'into the middle of the sickness thou shalt put').

Continuing with *IM.SAḤAR.PAR.KUR.RA* 'white *IM.SAḤAR* of the mountains', and *IM.SAḤAR.GIG.KUR.RA* 'black *IM.SAḤAR* of the mountains', we have here probably two substances similar to *IM.SAḤAR.TĀK.KUR.RA* 'stony *IM.SAḤAR* of the mountains', alum. The groups are similar, and *IM.SAḤAR* is a very uncommon prefix.

In *MT. IM.SAḤAR.PAR.KUR.RA* is to be brayed, wrapped alone in wool, and put into the uterus, for *menorrhagia* (an obvious styptic, as alum would be) *KAR.* 194, i. 33: and with *IM.SAḤAR.GIG.KUR.RA* and others similarly (*ib.* 43): for strangury with others, *AM.* 59, 1, 45 (cf. *ib.* 29, drink). *IM.SAḤAR.GIG.KUR.RA* is used to remove ringworm (itch, or sim.) (*PRSM.* 1924, 10: *AM.* 5, 5, 3).

Pliny (*NH.* xxxv, 52) mentions a white alum, for dyeing wool bright colours, a black for dyeing darker tints, and a kind called *schiston* splitting into filaments, and, in medicine, in various forms against itch-scab, pruriginous eruptions, and for discharges of blood. In *P.* 126 (cf. *BMM.* 63) alum is used as astringent, a mouth wash, styptic, for gonorrhoea, a nasal douche, purulent ophthalmia, internal haemorrhage and menorrhagia, and for excessive secretion in dysentery.

IM.SAḤAR.TĀK.KUR.RA, *gabû* ('stony alum') may well be the hard alum, and the other two, 'white' and 'black' (liquid) alum respectively. Berthelot (*Coll.* 237) says that the blackness of the alum was probably caused by contact with vegetable juices.

Alum comes from Shap Ma'den (near Kara Hissar, Siwas, *Narr.* 129): Tuz Khurmati (*ib.* 495): Hamairan (Persian Gulf, Pilgrim, *MGS.*, xxxiv, 157).

2 (o) Amna(k)ku, immanakku, ^aIM.MA.NA, ^aIM.MA.AN.

NA (see ^aPAR, No. 17 (a)), the white sand used for making glass.

It is one of the two chief components of the simplest frit or glaze in the Glass-texts, along with alkali (omitting the small quantity of *styrax gum for an uncertain purpose) *OTC.* Sect. B.: Appendix i, Sect. B. The essential silica component must be concealed in the word which plays so important a part in these texts in the forms *IM.MA.NA* (and in *AM.* 47, 3, iv, 32, ^a*IM.MA.AN.NA*) and *amna(k)ku* (*immanakku* as equivalent to *IM.MA.NA*, Geller, *AOTU.* i, 310, 25, and 357). It is not, however, the usual word for sand in Assyrian which is *baššu* or *hūlu*. It must represent the special sand used for glass-making, probably a pure quartz sand. For many ages the only spot which afforded the sand for making glass was the traditional place where glass was first accidentally made (Pliny, *NH.* xxxvi, 65), the river Belus, the modern Na'man, which flows out into the Mediterranean near Acre. Theophrastus (3rd cent. B.C.) mentions the sand of this river for making of glass (Dillon, 77), and it was long after transported to other countries for this purpose (Strabo, *Geog.* xvi, ii, 25; Josephus, *De Bell. Jud.* ii, 9; see Fowler, *Archaeologia*, xlvi, 83). Possibly the Sumerians might have purchased it for their glazes from Syrian caravans, and, if so, there is just a possibility that the name of the river Na'man bears an echo, indirectly, of the Sumerian *IM.MA.NA*, which, as we have already mentioned, occurs in a Sumerian religious text:

UR.SAG ^a*IM.MA.NA* *BA.GUB*

'The hero stood on the sand.'

It would not be the first time that Na'man has had a philological connexion with a foreign word, for is not the Greek word *anemone*

supposed to be related? With very great hesitation, we might note the similarity in sound between the Assyrian *immanaku*, *amnaku*, and the Greek ἀμμοκόνη, a calcareous sand.

In *MT*. it has no medical value, but is used probably to hang on (pelvis (?), or neck (?)) (*AM*. 47, 3, iv, 32): in an incantation (*AM*. 33, 1, 22, cf. *JRAS*. 1931, 3): and possibly *AM*. 91, 1, 1, where *aIM.MA AN.NA?* is to be hung on the neck. It occurs on *CT*. vi, 12, 11, *a* as *aKISIB.IM.AN.NA* (note *SC*. 8, mentioning a plaque of *bitumen*, and clay or sand, Gudea period).

3. THE DRUGS FROM THE RIVER

- 3 (a) *Kibir ilunâri, kibritu, KI.A.AN.ÎD*¹, black sulphur.
 3 (b) *Ru'ut ilunâri, ÚĤ.AN.ÎD*, yellow sulphur.
 3 (c) *A.GAR.GAR.AN.ÎD*, bitumen: *iddû, ESIR*, bitumen: *kupru, ESIR.UD.DU.A*, pitch.
 3 (d) *Pappasi nâri, BA.BA.ZA.AN.ÎD*, probably the gypsum of the Euphrates.

3 (a) *Kibir ilunâri, kibritu, KI.A.AN.ÎD*, black sulphur.

3 (b) *Ru'ut ilunâri, ÚĤ.AN.ÎD*, yellow sulphur.

In addition to the well-known equivalences, there are the longer given in v R. 27, 1, 12, a-b:

KI.A.AN.ÎD.MULU.RU.GÛ = kibri ilunâri
[ÚĤ].AN.ÎD.MULU.RU.GÛ = rutti ilunâri

CT. xxxvii, 27, 34, 35:

*KI.A.AN.ÎD.ĤAL.ĤAL*² = *ki-i [b-ri-tu]*
KI.A.AN.ÎD.A.RAD = ru'ut [nâri]

which, with *ib. 11*, allows us to restore CT. xiv. 9, r. iii, 4-6:

KI.A.AN.ÎD.ĤAL.ĤAL = KI.A.AN.ÎD
KI.A.AN.ÎD.A.RAD = ÚĤ.AN.ÎD
IM.GÛ.EN.NA = ĥa-a-pu

(i.e. 'bank of the Tigris = *kibritu*, bank of the Euphrates = *ru'ut nâri*', followed by *IM.GÛ.EN.NA* = 'bank', *ĥâpu*, the Heb. *hoph.*, No. 2 (g)). Each of the above drugs usually occurs separate, but *ĵRAS.* 1924, 454, 12, ff. (BRP. 32) shows *kibir ilunâri* added to the others:³
KI.A.AN.ÎD.ÚĤ.AN.ÎD = kibrit ilunâri aruġtum = 'yellow bank of the river'.

KI.A.AN.ÎD. A.GAR.GAR.AN.ÎD = kibrit ilunâri řalindu
 = 'black bank of the river'.

KI.A.AN.ÎD. BA.BA.ZA.AN.ÎD = kibrit ilunâri piřitum
 = 'white bank of the river'.

In *PRSM.* 1924, 2, I showed that *KI.A.AN.ÎD, kibir ilunâri* (*kibritu* in *AM.* 33, 1, 35, 36, and *kibrit*, CT. xxiii, 26, 10), thanks to the suggestion of Miss A. M. Lunn, B.Sc., before whom I had put the evi-

¹ Note the distinction, e.g. in CT. xxxix, 14, 12, where *KI.A.ÎD*, without *AN* represents 'bank of the river'.

² CT. xli, 45, No. 76487, 9, explains *ĤAL* in *ĤAL.ĤAL* of the Tigris as equivalent to *řarara řa mēbl*, 'eddies of water'.

³ This inclusion of sulphur and bitumen under a common heading shows that the Assyrians (like Pliny, *NH.* xxxv, 51) recognized the association of the two.

dence, is obviously sulphur, the Arab. *kebrīt* and the Heb. *gophrith*. The term 'bank of the river' as expressing the locality in which the substance it represents is found (which should, by our argument, be sulphur) is apt: the Tigris has several sulphur springs on its banks, and at the foot of the cliffs of Mar Gabriel, and there are mines of sulphur eight miles distant from Mosul (*A.*, 258, 259: cf. Bar Bahlul, *HS.* ii, 132, from Barimma, between Mosul and Tekrit): Kifri (*Koord.*, 29, used locally for itch).

In *MT. KI. A. AN. ĪD* is used (*a*) in *fumigation*. The fumigation is, of course, primarily to drive away evil spirits by the evil smell produced. In the Greek papyri (Leemans, *Pap. Gr.* ii, 100, 30 ff.) a demon is to be driven out by applying sulphur and bitumen to the patient's nostrils. Doubtless the pungency of the drugs may have revived the patient, just as syncope is treated nowadays with smelling salts, ammonia. For 'Hand of Ghost', fumigate with others, *AM.* 33, 1, 9 (with *ku-up-ri*, dry bitumen, following): 103, 15. *Sunstroke* (*enuma amelu kima* (?) *šurdu ša ilu Šamši mariš*, in prescriptions for *šiggati* 'blains') 'with seven and seven (heaps of) dung (*putri*) . . . and black sulphur' fumigate the patient for thirty days, and sprinkle him for seven days with urine (*AM.* 51, 4, 5, *RA.* 1930, 131), the use of ammonia (as mentioned above) being obvious. Fumigate ears with *kib-ri-tū* 'sulphur' (*AM.* 33, 1, 35, 36) with others, and fumigate or anoint a man sick of *šimmat* 'poison' with black sulphur, turmeric, pitch (*ESIR. UD. A.*), and kelp (?), *AM.* 91, 1, r. 1 (the next prescription being for scorpion-poison, in which a patient is revived by having his nerve-centres stimulated by pungent smells): for when the [head] *NE.NE.IM*, fumigate it with *kib-rit* (black sulphur) and other ill-smelling drugs (*CT.* xxiii, 26, 10): when a ghost approaches (*iṭehhi*) use black sulphur, *UḪ. AN. ĪD* (yellow sulphur), male and female opopanax (*nikibtu*), seed of tamarisk (= galls, kelp (?), &c., as a fumigation, and anoint with cedar oil (all being unpleasant-smelling drugs) (*KAR.* 182, r. 11). Cf. also *gibilla ina išat KI. A. AN. ĪD ta-kaḍ-ma* 'thou shalt light a match (brand) in a fire of sulphur' (iv *R.* 55, 2, 17),¹ and the use of *KI. A. AN. ĪD* in a sulphur-soap in a ritual (*KAR.* 43, 8, dup. 63, 8) to remove hatred: Take the saliva of the man who is angry with thee: recite a (prescribed) incantation three times over it, and then bury it in the earth: then on the same day take and Bray together pine-turpentine, black sulphur, and salicornia alkali, put them in water, reciting an incantation ('My alkali is salicornia alkali')

¹ It is possible that we have here a reference to the 'sulphur match' (in use before our present-day matches came in). 'The word "match" was further used of a splint of wood tipped with sulphur so that it would readily ignite. . . Till the beginning of the nineteenth century flint and steel with tinder-box and sulphur-tipped splints of wood—"spunks" or matches—were the common means of obtaining fire' (*EB.* 11th ed., xvii, 876). Pliny (*NH.* xxxv. 50) speaks of one kind of sulphur used in the preparation of matches more particularly.

over them: then pour out (*ELTEG*) this 'water' on this saliva. The saliva is then to be mixed with oil and the man to be rubbed therewith, and then the hatred of his adversary will be assuaged. The hatred of the enemy, which is thus typified by the saliva which, doubtless, he has expectorated in the usual venomous way of the Oriental when his foe passes by, will be washed clean from the saliva by sympathetic magic, these drugs forming nothing more nor less than a good sulphur soap ('in workhouse practice the preferable mode of employing sulphur is by uniting it with soft-soap', *PC.* xxiii, 1842, 263). The man is then rubbed with the neutralized saliva and oil, to indicate his association with the sterilization of his enemy's expression of hate.

In *MT. KI. A. AN. ÎD* is used (*b*) *ext.*: for *head*, for itch (scabies), *AM.* 1, 2, 8, dup. *KAR.* 202, ii, 3: also *ib.* 9, almost certainly heat [*KI. A. AN. ÎD* (?), *ina šaman kaḫḫad-su tuḫḫa* (in the oil of his head thou shalt cool, or, in oil thou shalt cool his head), for similar trouble. Cf. also *AM.* 3, 5, 4, where it is prescribed for head alone, in mountain honey. For *šiggati*, some form of *blains* or skin trouble, with others, *AM.* 32, 5, 5, and 7, to be applied *ext.* For a 'pricking' (sore) *heel*, with opopanax and kelp (?), as an *ext.* application in oil, *AM.* 75, 1, iv, 25+15, 3, r. 4. For *eyes*, *ext.*, followed by *kupr[a]*, with others, *AM.* 19, 6, 14: to stay menses, applied to uterus on wool, with others (alum, saltpetre), *KAR.* 194, 43. For *loins* (pain), *AM.* 53, 1, iii, 5 (cf. Pliny (*NH.* xxxv, 50) for 'lichens on the face and leprosy', morphew, nits in the hair, in poultices, and on the loins in grease. Modern (*P.* 1178), for scabies).

Since *KI. A. AN. ÎD* is a form of sulphur, *ŪḤ. AN. ÎD* (amplified as *KI. A. AN. ÎD. ŪḤ. AN. ÎD = kibrit ilu-nâri aruḫtum*), 'spittle of the river', 'yellow bank of the river', will be the yellow sulphur, and therefore *KI. A. AN. ÎD*, as the other, will be the black. Both kinds are sold by the druggists in Mosul, the *kebrît aswad* (black) from Hammam Ali for *ext.* use, and the yellow from 'Ain Kebrît internally. These distinctions are expanded in Arab chemistry (*MASB.* 371) into red, bright yellow, white, white mixed with earth, and black of two kinds. 'Spittle of the river' as yellow sulphur, is intelligible when we consider that expectoration (phlegm) becomes a yellow or greenish colour after bronchitis has existed in the patient for some days (*DM.* i, 471).

In *MT. ŪḤ. AN. ÎD* is used (*a*) in *fumigation*: when a ghost lies on a man, with others, *AM.* 99, 3, 18: for *temples* (?) *AM.* 14, 4, 4. It is used alone with *KI. A. AN. ÎD* in a plain fumigation at a sacrifice (but fumigation is difficult to understand) (*BBR.* No. 11, 9). The two sulphurs are thus used together. Again, in a comparison of the two similar texts (for temples), *AM.* 103, 15 and 2, 1, 15, *KI. A. AN. ÎD* and *ŪḤ. AN. ÎD* of the former would appear to be replaced by *KI. A. AN. ÎD piṣū u ṣalmu* 'white and black sulphur' in the latter.

(*b*) *Ext.*: to bind on *temples* with black sulphur, kelp (?), *amuṣa* (sul-

phate of iron), mixed with cedar oil and wrapped in red wool (*AM.* 4, 6, 4): for some *skin trouble*, apply with eight others (*AM.* 44, 1, ii, 6): for the 'Hand of a ghost', or 'Hand of Ishtar', when the right temple hurts, and the right eye is inflamed, one shekel with other drugs mixed in crushed flour and steeped in beer is to be bound on (*CT.* xxiii, 43, 8); against 'Hand of Ghost' wrapped in red wool and bound on temple (*AM.* 103, 15): against *ghosts*, cf. *KAR.* 56, 7: 182, r. 25: and *AM.* 29, 1, 3 (+*CT.* xxiii, 22). Alone in beer, use uncertain (*AM.* 32, 1, 6).

In *AM.* 1, 2, 9 [*KI. A. AN. ĪD* or [*ŪḤ. AN. ĪD* burnt and applied in oil to scabies and itch, must be the flowers of sulphur (a fine powder, deposited from the vapour of sulphur after sublimation) (paralleled by *ītru ša tābtī*, ammonia, *ib.* also burnt).

A *ru'ut* (*ŪḤ*) *tāmti* 'spittle of the sea' occurs, *AM.* 48, 1, 8.

To sum up: *KI. A. AN. ĪD*, *kibir ilunāri*, *kibritu*, 'the bank of the river', the product of the bank', so called from the locality where it was found, the Arabic *kebrīt*, sulphur, must be the black form, as distinct from *ŪḤ. AN. ĪD*, *ru'ut ilunāri*, the yellow sulphur, defined as such on p. 38. Both are used medically as we should expect sulphur to be used.

3 (c) A.GAR.GAR.AN.ĪD, bitumen: iddū, ESIR, bitumen: kupru, ESIR.UD.DU.A, 'dry bitumen': ḥaṣabtī nāri (see No. 2 (i)).

A.GAR.GAR.AN.ĪD 'dung of the river', the 'black *kibritu*' ('bank-stuff, sulphur') of the river', (p. 38), must surely be the bitumen¹ which floats on the water near Hammam 'Ali, a short distance below Mosul ('with lumps of bitumen floating about in it') (*AD.* 96, and cf. *Tr.* 149). Pomet (*HD.* 394) speaks of bitumen as *stercus diaboli*, and (*ib.* 387) says that 'asphaltum is a bitumen found swimming upon the waters of the lake where heretofore stood the Cities of Sodom and Gomorrah'. It also comes from Qayyarah (near Kalah Sherghat *Tr.* 152); Hit; between the Zagros and the Tigris; and from Persia on both sides of the Karun (for these last localities, see R. J. Forbes, here below). R. J. Forbes, an authority on bitumen, in a type-script brochure thus refers to this expression for bitumen (which I had sent him in a letter):

"The expression "dung of the river" is certainly a striking description of the manner in which bitumen is found at Hit even up to the present day. Spielmann (*J. Inst. Petrol. Techn.*, Dec. 1931, 738) says about this: "At the present time asphalt is collected near Hit as it comes to the earth's surface. Water rises with varying velocity, sometimes accompanied

¹ See *JSOR.* 1931, 57. *A.GAR.GAR* is the dung of a gaminivorous animal, *KAR.* 165, 12.

with so much gas that the latter will burn after being ignited. In the water are 'snakes' of asphalt, which collect together and are consolidated by the natives by hand pressure into lumps, which are then thrown aside": and in his enlarged and subsequent brochure, *Bitumen and Petroleum in Antiquity* (1935), he again confirms this description, saying that this name 'dung of the river' is an exact description of the appearance of bitumen in seepages or pools. He mentions the 'high sulphur content of the bitumen used in the [ancient] samples derived from Tell Asmar', which shows why the Assyrian chemists, connecting sulphur and bitumen, have included *A. GAR. GAR. AN. ĪD* under the common heading *kībritu* 'sulphur'. Pomet (*HD.* 389) goes so far as to describe 'Sulphur Mineral' as a 'hard earthy bitumen of a yellow colour'.

In *MT.* *A. GAR. GAR. AN. ĪD* is used apparently in fumigation with yellow sulphur and turmeric, &c., *AM.* 78, 10, 4; and to fumigate feet, *AM.* 70, 3, 1: its black colour is contrasted with the white of tragacanth (*maštakal*), the two being used on a pledget of red and white wool as a plug for menorrhagia (see under *adbaru*, 21 (e)). Cf. Epping-Strassmaier, *ZA.* vi, 242, 15 (see Langdon, *Sum. Lit.* 339) where *ESIR* stands for the *ašakku*-demon, i.e. the black substance is the power of evil (as against the white of *IM. PAR*, 'gypsum', *ib.*).

The less cryptic words for bituminous substances are *ESIR* (*iddū*) and *ESIR. UD. DU* (*kupru*) (kept separate, Ch. F. Jean, *Larsa*, 33): (cf. both mentioned on a text, *RUL.* 231). Since *UD. DU* means 'dry', *ESIR. UD. DU* (*kupru*) will mean the drier bitumen, as against *ESIR* (*iddū*) a moister kind.¹ Another kind, *ESIR. IGI. ENGUR* was brought by Gudea from Madga² (*ISA.* 111, 51), and other kinds are given on a tablet from Tell Loh (*ITT.* 1: see also *IV R.* 55, i, 28 and *D.* 487). In late Babylonian times *ittū* and *kupru* are mentioned on the same tablet (*Camb.* 105, 1) and in a historical inscription (*NK.* 60, ii, 11). *Kupru* is used for work on a boat (for the seams, rather than tarring?, *KAR.* 69, r. 11: *LZ.* 20, *kima kupru iṣbattu ielippi*!).

In *MT.* *iddū* is prescribed, ext., on a festering foot and finger (*AM.* 15, 3, r. 7) with others: *kupru*, with black sulphur, salicornia alkali, a hair from a lion's skin (whatever alchemist's synonym this may be), &c., in cedar oil, against ghosts, exact use uncertain (*AM.* 38, 6, 7, added to *K.* 2175, iv, *CT.* xxiii, 22, 44). Curious is the direction for *kupru* in *AM.* 13, 4, 4: 32, 2, 3: 90, 1, r. 7, 12, 18, 22, that the patient shall stand on it. *ESIR. UD. A* (*kupru*), followed by *KI. A. AN. ĪD* (black sul-

¹ The form *ESIR* goes back to the Third Dynasty of Ur, (Contenau, *Umma*, 41).

² 'The Mountain of the River *GALU. RU. DA*'. Madga is not far from Hit (Boson, *Fr.* 18), and since gypsum also came thence, we have a coincidence in the gypsiferous outcrop at Hit (*G.* 17, 63). Since a 'boat of Madga' is mentioned (*RTC.* 235, 18) Madga must be near water.

phur), &c., prescribed prob. ext., *AM.* 98, 3, 16, and *kupra* follows *KI.A.AN.ÎD* with others in a fumigation against a ghost, *AM.* 93, 1, 11 (cf. *AM.* 91, 1, r. 2 and 92, 4, r. 2). Figures are made of *kupru* (*LZ.* 34, 22).

Accepting *iddû* and *kupru* as the moister and drier forms respectively, the probability is that the *A.GAR.GAR.AN.ÎD* (which floats on the river) is the simpler (moister) form before it has thoroughly dried. This may be supported by the occurrence of *ḥaṣabti nâri* (which is probably the equivalent of *A.GAR.GAR.AN.ÎD*, No. 2 (i)) along with *kupra* (*AM.* 85, 1, 10), which suggests that *A.GAR.GAR.AN.ÎD* = *ḥaṣabti nâri* (see No. 2 (i)). But that the distinction may have been found difficult to maintain is suggested by the Syr. *kûphrâ n'hôrâyâ* 'riverain kuphra' (*SM.* i, 605). Like *A.GAR.GAR.AN.ÎD*, *iddû* would appear to be brought into definite connexion with the River-god in *BBR.* 27, 11, in a list of objects and substances with their appropriate patron-deities, i.e. *iddû* = ^{ilu}Nâru. Doubtless the name Hit, "Is is the same word as *ittû*, *iddû*, bitumen: cf. Tukulti-Ninurta ii (Scheil, *Annales*, 17): 'In front of Hit (^{alu}ÎD), by the bitumen-springs, the place of the *uṣmeta* (or *uṣṣipta*) stones' in which the gods speak, I spent the night.' For the bitumen fountains of Hit 'evolving gases in abundance' (i.e. 'in which the gods speak'), see *A.* 86.

A word *amaru* existed in the time of Samsu-iluna, for which Meissner (*Beitr. z. Bab. Privatr.* No. 26) suggests the Heb. *ḥēmâr* 'asphalt'.

Petroleum is *šaman iddî* 'oil of bitumen', *NI.GIŠ.ESIR.* Meissner (*MVAG.* 1905, 4, 79) quotes Boissier, *Divin.* 247, 53 and 56 (*CT.* xxxix, 19, 121) *Šumma ina pâni mê kima šaman iddî ditto kima šamni iḫkašruma iḫkilippû ṣirgaru u NE.A.ŠĀ.GA mâta iṣabat* 'If on the face of water it were as if oil of bitumen (or) oil were coagulated and ran about, serpent(s) and *NE.A.ŠĀ.GA* will seize on the land', and *Šumma nâru mû-ša kima šaman iddî u kima šamni nâru ubbal ummanam sunku iṣabat* 'If the water of a river bears (something) like oil of bitumen or oil, want will seize on the people'. The burning wells of Kerkuk Baba are suggested in the omen 'When in ditto a pit opens and *iddû BIL*, "burning bitumen" appears' (Gadd, *CT.* xxxix, 22, 10). On *naptu* 'naphtha', see *Bab.-Ass.*, i, 349: for *NI.KUR.RA* 'mountain oil' (= petroleum) see *AM.* 18, 3, 3: 73, 1, ii, 8 (for anointing): *BBR.* 41, 17.

3 (d) Papasi nâri, BA.BA.ZA.AN.ÎD, the gypsum of the Euphrates.

'The white bank of the river' (p. 38), parallel to *A.GAR.GAR.AN.ÎD* 'the black bank of the river' = bitumen. Since the powers of evil and good are represented by the black of bitumen and the white of

¹ *aUš* [sic]-šip-ta.

gypsum (plaster of Paris) (No. 3 (c)), it is reasonable to see in this 'white bank of the river' some form of gypsum, as opposed to the black bank, bitumen. Actually west of the Euphrates is found a *jus* or calcareous earth (see No. 18 (a)). Now *pappasu* means 'meal' or 'flour' (Hrozný, *Getr.* 104), with the property of adhering when moistened, and the same property belongs to plaster of Paris. Moreover, since there is a mill for grinding gypsum, at all events nowadays (*Koord.* ii, 71, see No. 18 (b)), and gypsum is made by baking, although the process is in inverse order to the making, kneading, and baking of flour, the parallels are near enough.

In *MT.*: for *urinary* trouble, drink (probably) with many others: *AM.* 58, 4, 8: for *menorrhagia*, with many others, drink, *KAR.* 194, iv, 37. *Ext.*, on *feet*, *AM.* 70, 3, 1: *AM.* 70, 7, ii, 5 (*BA. BA. ZA. I. TI*): *body*, in poultice or sim. *AM.* 62, 3, 7.

Plaster of Paris does certainly not recommend itself for internal use, but the amount must have been very small in both the receipts given above. It is of more use ext.

(On *IM. PAR* as gypsum see No. 18 (b).)

4. THE ARSENIC GROUPS

(for the list see further)

There is a large series of mineral groups ('M', 'N', 'P', 'Q', 'R', 'S', 'T') of which the main Semitic values are *šīpu* or *lêru*, which, as equivalents of each other and of *šindu hurašu* 'gold paint', were considered to be 'Goldleiste', 'Goldlehm', and 'Goldpaste' by Delitzsch (*HWB.* 645) and Jensen (*KB.* vi, 510), both reading *šību*,¹ on which Langdon improved with Syr. *šīphā*, *š'yāph'thā* 'liquid gum' (*OLZ.* 1909, 111). I thought (*PRSM.* 1924, 24: *OTC.* 42) that we might go further than this, and see arsenic in these words. We can first discuss arsenic in the East in general, and then follow with a survey of the words of the *šīpu-lêru* group.

Realgar, the bright red sulphide, and orpiment, auripigmentum, the brilliant golden yellow sulphide, must certainly have been known to the Assyrians, who also seem to have known the native arsenic, but it is uncertain if they also had a fourth kind mentioned by Agricola (*De Re Metallica*, Hoover, 111, *lapis subrutilus atque splendens* (arsenopyrite)).

The two first forms have long been found in the Near East: realgar, sandaraca, from Paphlagonia (Strabo, J. Berendes, *Des Pedanios Dioskurides aus Anazarbos Arzneimittellehre*, 531: Pauly-Wissowa, *Realencyc.*, ii, 1273): and auripigmentum, probably from Carmania (Pliny, *NH.* vi, 26), from Mysia, Pontus, Cappadocia, and Syria (Berendes, *l.c.*): Syr. 'Earth of Armenia' (= 'golden arsenic', *HS.* ii, 15). The arsenic called *turāb el-hālak* in Iraq 'the earth which kills' came from Khorassan (*IB.* 1336). All this is confirmed by later authorities: Rich (*Bab. and Pers.*, 265), of orpiment from Shiraz: Olivier (*Voyage*, i, 358) from the interior of Asia Minor: and realgar and orpiment from Takhti-Sulaiman and in Kurdistan (*G.* 70). A lump of auripigmentum was actually found in the excavations at Zinjerli (V. Luschan, *Ausgrab.*, 261, quoted by Meissner, Ebert, *Reallexicon*, i, 278). Orpiment was used as paint in Egypt not earlier than the XVIIIth Dynasty (*AEMI.* 292). It should be added here that medicinally arsenic is not poisonous (as distinct from the deadly qualities of an overdose) and the inhabitants of Styria are said to consider that, by eating it, their endurance is increased (*EB.* 14th ed., ii, 437).

Accepting, therefore, that there is no difficulty in recognizing that the ancient Assyrians were able to obtain arsenic easily, we can follow up the identification of this mineral with the *šīpu-lêru* group which I append below. I am suggesting that those equivalences which contain

¹ On *šību* see also Zimmern, *Akkad. Fremdw.*, 61; Strassmaier, *AV.* 8252.

the word *GUŠKIN* 'gold' represent realgar, while those defined with the paler yellow *SIG₇* or *SIG₇.SIG₇* are orpiment.

Realgar:

4 (a) *ŠIM.ŠE.ṬU.GUŠKIN* = *šindu ħurašu*, 'gold paint', 'M' 8. *Šindu*, according to Pinches, 'probably not "spot", but certainly "mark"' in the expression 'an eight-year-old brown donkey without *šindu* on it' (*JRAS.* 1898, 444, *MA.* 1072). 'Paint' on the other hand, seems probable in 'sixteen mana of *ši-in-di* for Šitkul and his brothers, the carpenters' (Str. *Nbk.* 126, 1): 'five mana of *ši-im-d[i]* for Šitkul' (*ib.* 130): 'four mana of *ši-in-du* for Marduk-našir, the carpenter' (*ib.* 222) 'six *ma-su* (!) *ŠE.ṬU* for the door' (Clay, *BE.* xiv, 28, period of Nazi-Maruttash). Cf. also Langdon, *OLZ.* 1909, 112; Dougherty, *Shirkutu*, 84; and esp. Thureau-Dangin for *šindu namirtu* 'pure varnish' (?), *RA.* 1920, 74, 11, and 103. It is perhaps the Arab. *wasm* (Ungnad, *OLZ.* 1908, *Beih.* ii, 23) or perhaps *šamah* 'mark'. Possibly sandaraca is a garbling of an (invented) group *šindu arku* (not known to exist) 'yellow paint', but properly sandaraca is the red realgar. Again, perhaps *šindu ħurašu* might, from its meaning, be properly auripigmentum, rather than realgar: but, judging by the way in which *damatu* ('blood colour'?) is used as equivalent for *ŠIM.GUŠKIN*, *IM.SIG₇*, *IM.SIG₇.SIG₇*, or *IM.GÜN.NU*, there may have been confusion between the two forms of arsenic.

4 (b) *ŠIM.BI.GUŠKIN*, 'its (?) *ŠIM* is gold': = *lêru*, 'P' 24: 'Q' 20: = *šīpu*, 'P', note: 'Q' 19. In *MT.*: for eyes, with *AŠ.MUR*, &c., *AM.* 12, 8, 6: 20, 2, 6: brayed alone (?) in . . . (?) *AM.* 15, 4, 2: for mouth or tooth, *AM.* 36, 2, 3: to be drunk with others in oil and *kurunnu*-beer, *AM.* 16, 4, 5. Pliny prescribes sandaraca for eyes, fauces, and coughs (*NH.* xxxiv, 56).

4 (c) *ŠIM.GUŠKIN*, '*ŠIM* of gold': = *lêru* 'S' 2: = *šīpu*, 'M' 9: 'P' 21: 'Q' 15: 'R' 16: = *damatu*, 'N' 7: 'P' 27.

4 (d) *IM.GUŠKIN*, 'gold clay': = *šīpu*, 'P' 23: 'Q' 17: = *kalû* (yellow ochre, 2 (I)), 'T' 32: = *illur pâni* (*illurû*?) ('bloom of the face') (cf. the yellow colour of the Sumerian head from Kish, No. 2 (I)): 'M' 17: 'S' 12: 'T' 32: = *šaršeru* ('rouge'), 'R' 26. To be drunk with *IM.SIG₇*, *SIG₇* (orpiment) *IM.KAL.LA* (sal ammoniac), and alum in beer for some female trouble, *KAR.* 194, iv, 3. Arsenic (acidum arseniosum) is a 'general tonic' (*P.* 14) and as such, perhaps, might be used in the Assyrian prescription, since 'nervine tonics' are prescribed in modern times for amenorrhoea, (*P.* 1342). *IM.GUŠKIN* came from the King of Magan (prob. eighth year of Bur-Sin, Legrain, *RA.* 1933, 119), and occurs also in Scheil, *RA.* 1921, 6 (Epoch of Ur).

4 (e) *ŠIM.SAḤAR.GUŠKIN*, 'ŠIM of gold dust': = *lêru*, 'Q'
23. Perhaps = *SAḤAR.GUŠKIN*, for eyes, *AM.* 8, 1, 26.

4 (f) *IM.ŠIM.GUŠKIN*, 'clay of gold ŠIM': = *šîpu* = *šindi*
ḥuraši ('gold paint'), 'T' 30.

Orpiment:

4 (g) *ŠIM.BI.SIG₇.SIG₇*,¹ 'its (?) ŠIM is very yellow': = *lêru*,
'P' 26: 'Q' 21: = *šîpu*, 'P' 22: 'Q' 16: 'R' 17: = *damatu*, 'R' 18. For
eyes (like sandaraca, 4 (b)), *AM.* 8, 1, 28, 31 (the latter alone in *ḥimetu*-
ghee).

4 (h) *IM.SIG₇*, 'yellow clay': = *damatu*, 'N' 5.

4 (i) *IM.SIG₇.SIG₇*, 'very yellow clay': = [*egû*, 'M' 12?]:
= *damatu*, 'N' 6: 'S' 11: = *guḥlu*, 'T' 27.

4 (j) (*IM*).*ŠIM.BI.ZI.DA.SIG₇.SIG₇*, 'very yellow ŠIM.BI.
ZI.DA': = *AS.ḤAR*, 'M' 14: 'T' 29: = *Sin-kaḏrû*, 'T' 29 (reading
IM.ŠIM.BI.ZI.DA.SIG₇.SIG₇).

Other forms for *lêru*, *šîpu*, and *damatu* are:

4 (k) *ŠIM.TÂK.SAḤAR*, 'ŠIM of stone-dust': = *lêru*, 'M' 10.

4 (l) *ŠIM.SAḤAR*, 'ŠIM of dust'; = *lêru*, 'P' 25: 'Q' 22: 'R' 15:
'S' 3: = *šîpu*, 'P' note: 'Q' 18.

4 (m) *IM.ŠIM.TÂK.SAḤAR*, 'clay of ŠIM of stone-dust'
= *lêru* = *šindi šal(ni)*[-...] ('... paint?'), 'T' 31.

4 (n) *damatu* = *ḥurḥura*[*tu*],² 'N' 8: 'P' 28: 'T' 33.

4 (o) *IM.GÛN.NU*, 'clay of two colours':³ = *dama*[*tu*] = *ḥur*-
ḥ[uratu], 'T' 33: *a-[d]u-mat* 'red-brown' (-drug),⁴ 'M' 16, and *IM*.
GÛN.GÛN.NU = *damatu*, 'S' 10.

4 (p) ... *gamgamme* = *lêru* (?), 'R' 14. Probably distinct from *kam*-
kama ša šadi (the latter to be inserted in the ears with the gall of an ass
and [the dung (?) or urine (?)] of a dog (*AM.* 36, 1, 9: *ṢRAS.* 1931, 11)

¹ Doubtless distinct from *aSIG₇.SIG₇*, 'very yellow stone', *CT.* vi, 11, ii, 38:
(= *urriku*, *CT.* xii, 49, 29): one of fourteen to turn evil dreams to good fortune
(*KAR.* 213, 29). In *MT.* against the Hand of Ishtar (with *aPAR.AŠ*, *aḏuša*, and
aLAL(?), *KAR.* 186, 32): uncertain use (with *aAŠ.GÌ.GÌ*), *AM.* 29, 2, 9: for
singing ears (with *aAŠ.GE₄.GE₄*, &c., in cedar oil) *AM.* 33, 1, 26. See No. 38.

² Meissner, *Beitr.* i, 47.

³ The pictures of both realgar and orpiment in *WM. pl.* 4 show vivid yellow
and red.

⁴ Cf. Pliny, *NH.* xxxiv, 55, of sandaraca: 'The redder it is, the more pure
and friable.' Its property as a friable mineral is shown in Assyrian by the
frequent inclusion of *SAḤAR* 'dust'.

(cf. *SM.* ii, 664, for gall and urine of goats for ears), thus a reduplicated form, probably, of *kammu* 'gall, tannin' (*JRAS.* *ib.*).

Throughout the above it is obvious that there are many expressions, homogeneous in character, constantly equated with both *šīpu* and *lêru*, for a mineral of which the characteristics are either gold colour or yellow. As has already been said, if we were allowed to substitute the word *arḫu* 'yellow' for *hurašu* 'gold' in the phrase *šindu hurašu*, and assume a mineral *šindu arḫu*, 'yellow paint', we should be very near a possible original for sandarach, realgar. Every detail in their use points to arsenic, i.e. realgar or orpiment.

4 (q) *Šīpu* and *lêru*. But what are *šīpu* and *lêru*,¹ the persistent equivalents for both? We have already seen above that Langdon has associated the Syr. *šīphā*, *pasta*, with *šīpu*: it would seem that *lêru* may be connected with Heb. *rîr*, the Arab. *râl* 'slaver' (*PRSM.* 1924, 24). But both these cognates suggest a general word for something (colourless) smeared on, while the Assyrian words are apparently distinctly connected with gold or yellow. In one case ('T' 30, 31), however, *IM.ŠIM.GUŠKIN* (definitely of gold) = *šīpu* = *šindi huraši* (gold paint), while *IM.ŠIM.TÂK.SAḪAR* (not necessarily gold) = *lêru* = *šindi šal* (or *ni*) . . . paint of some colour (?), so that, although *šīpu* is properly 'gold paint' here, it is contrasted with *lêru* as a paint of uncertain substance, not the same, in this instance, at least. The same distinction is to be inferred from 'M' 9, 10, where *ŠIM.GUŠKIN* (i.e. without the addition of *IM*) = *šīpu*, as contrasted with *ŠIM.TÂK.SAḪAR* (similarly without *IM*) = *lêru*. But that *lêru* may certainly have a yellow colour is obvious from 'P' 24 (= [*ŠIM*].*BI.GUŠKIN*), and 26 (*ŠIM.BI.SIG₇.SIG₇*).

Following this up, the groups containing *TÂK.SAḪAR* (i.e. *IM.ŠIM.TÂK.SAḪAR* and *ŠIM.TÂK.SAḪAR*) appear to have some difference from the other groups containing *SAḪAR* simply, without *TÂK* ('stone'). It is true that *ŠIM.SAḪAR* may have the equivalence of *šīpu* as well as of *lêru*: that *ŠIM.SAḪAR.GUŠKIN*, especially of gold, has the equivalence of *lêru*: but it certainly would appear that *IM.ŠIM.TÂK.SAḪAR* and *ŠIM.TÂK.SAḪAR*, although also equated with *lêru*, show nothing definitely yellow in their composition, and the former is, as we have seen, explained as *šindi šal*.. as contrasted with *šindi huraši*, 'gold paint'. May we assume, then, that *TÂK.SAḪAR* represents a hard but friable mineral, and that the lost word in the Assyrian for *IM.ŠIM.TÂK.SAḪAR* is *šindi šal*[*mi*] 'black paint' (native arsenic or antimony, p. 51)?

Further evidence must be sought in the group (*IM*).*ŠIM.BI.ZI.DA*

¹ On a contract (*Nbn.* 558, 12) 10 *mana li-i-ri eštenit(it) na-pa-ra-aḫ-tum* are mentioned.

(compounded with our word *ŠIM.BI.ZI.DA.SIG₇.SIG₇*, the very yellow *ŠIM.BI.ZI.DA*, 'orpiment') and equated in 'M' 11-13: 'Q' 3-5: 'R' 19, 20: 'T' 28: with *šimbizidū*, *egū*, *amamū*, *guhlu*, and *šadidu*.

These two last, *guhlu* and *šadidu*, were rightly identified by Zimmern (Gesenius, *Heb. Wörterb.*, 12. Auflage) with the Arab. *koḥl*, and the Syr. *šadidā*, eye-paint. *Guhlu* is equated ('Q' 6) with *tuskā*, spodos (a form of cadmia), (and . . . -*pā*, 'Q' 7: cf. 'T' 27), which is explicable from Pliny (*NH.* xxxiv, 22) who says that one form of cadmia (the red 'botryitis') is extremely useful for affections of the eyes. This is merely a form of zinc, long known in eye-salves: Fergusson (*Palaces*, 169) quotes a Persian author (who relies on an older one) as saying that in ancient times people would ascend to the tops of the columns of the Great Hall of Xerxes at Persepolis, to take earth and clay therefrom, which they crushed and found therein Indian tutty, useful as a medicine for eyes. 'Cadmin' is frequent in eye-salves in *SM.* ii.

Šadidu appears to be different: it is equated with . . . *GAR* (*šā*) *KŪ.DIM* ('Q' 8), and since *amKŪ.DIM* is a goldsmith or jeweller, *šadidu* here will be some jewellers' product, which, from its general connexion, will probably be Pliny's chrysocolla (*NH.* xxxiii, 29, 'the goldsmiths also employ a chrysocolla of their own for the purpose of soldering gold') called santerna, made of verdigris of Cyprian copper, the urine of an immature boy and nitre; chrysocolla (*ib.* 28) is an ingredient in eye salves. *Egū*, another equivalent of *ŠIM.BI.ZI.DA = IM* (?). *SIG₇.SIG₇*, 'very yellow clay (?)' which will be a form of arsenic, which again coincides with Pliny (*NH.* xxxiv, 55, and cf. 56), who says that sandarach was used in ophthalmic preparations. Arsenic is used in *SM.* ii, 90, 94, for eyes (the latter being 'lamellar arsenic', for which see text).

We may understand by *ŠIM.BI.ZI.DA*, therefore, eye-paint, collyrium, in general, whether made of zinc, chrysocolla, or arsenic.¹ Obviously we should have expected to find as an outstanding form of *koḥl* the modern antimony but, before deciding, it is important to note what *AEMI.* 79, ff. says on the subject: that in Egypt the two commonest

¹ As a cosmetic arsenic does not seem to have been used, although in the early days of the American Republic face-powders were occasionally made with bases of lead or arsenic salts (*EB.* 14th ed., vi. 487). But as a depilatory it was well known both in ancient and more modern times (orpiment thus used with lime, Mactear, *TIM.* 1894, 16). The use of *AS.ĤAR* in *MT.*, paralleled by cantharides, for 'growing flesh' (see further) indicates a belief in its virtue as an external drug (where nitrate of silver would be used in more modern times), but there are two instances of arsenic in *SM.* ii, 90, 94, for eyes, which indicate a mild drug. In *ŠIM.BI.ZI.DA* itself we have *ŠIM* used as a determinative to various gums and pleasant smelling drugs, and *ZI = napištu* 'life', but I doubt whether we can associate the *ŠIM.BI.ZI.DA.SIG₇.SIG₇*, 'very yellow (arsenic) life-drug' with the apparent property of arsenic to increase human endurance mentioned above, since there is no certain suggestion that simple *ŠIM.BI.ZI.DA* is peculiarly arsenic.

eye paints were malachite and galena (a dark grey ore of lead), galena occurring in 40 cases of analysis of *koḥl* out of 61, the remainder consisting of carbonate of lead (2); black oxide of copper (1); brown ochre (5); magnetic iron oxide (1); oxide of manganese (6); sulphide of antimony (1); malachite (4); and chrysocolla, a greenish-blue ore of copper (1). 'The general idea, therefore, that ancient Egyptian *koḥl*, except when it was green malachite or chrysocolla, always either consisted of or contained antimony or an antimony compound is wrong.'

But it is not the same, I think, in Assyria, where *LİŠ.A.BĀR* ('needles of "lead"'), i.e., stibnite or sulphide of antimony, is used for eyes (No. 12), and is even equated with what seems to be *AS* (not *ĀŠ*). *ḤAR*, which, by No. 4 (*u*), would appear to have arsenic as one of its values. But the evidence cannot be held to be at all conclusive that antimony is actually meant as one form of *ŠIM.BI.ZI.DA*. Shamshi-Adad crossed the *ŠIM.BI.ZI.DA* mountain, which lay near the town of Kinaki, in or near Gizilbunda (ii, 59 ff.), his previous mention of two-humped Bactrian camels showing that this must have lain in Media, and we have two possibilities for the identification of this place: (*a*) Afshar (so Meissner, *OLZ.* 1914, xvii, 54), a locality of antimony, 18 miles from Takht-i-Sulaiman: or (*b*) the mines of Zarshuran in this district, where traces of ancient mining are plentiful, affording orpiment (described by Mactear, *l.c.*: *G.* 70). Hence *ŠIM.BI.ZI.DA* might definitely include either arsenic or antimony, for all that can be inferred from the chemicals discovered in the mountain of *ŠIM.BI.ZI.DA*. Again, in *MT.*, where the physician must necessarily be definite, there is only one passage (as far as I have noted) where *ŠIM.BI.ZI.DAM* (*sic*) is used alone for eyes (in woman's milk, *AM.* 16, 3, 11+12, 3, 5, *PRSM.* 1924, 40). The neighbouring receipts contain simple salves (iron, carbonate of copper, &c.), and nothing drastic, so that we should hardly expect anything more than a mild drug. Other occurrences tell us nothing: *ŠIM.BI.ZI.DA* is crushed, anointed and worn on temples, *AM.* 102, 31, and a form *ŠIM.BI.ZI* (= *egû*, ii *R.* 36, 56, *g*: = *kuḥlu* (?), *liru* (?), 'R' 12, 13) exists, and is used as a mineral against all evil and 'the Hand of a Bull', *KAR.* 213, 3, 14: and, more definitely, *ŠIM.BI.ZI.IGI.GÛN* = *egû ša ekî* (lit. '*ŠIM.BI.ZI* for colouring the eye (or, face)', ii *R.* 36, 57, *g*).

The fact that *guḥlu* was taken as booty from Hezekiah by Senn. (*Luck.*, 34, 42) is no indication of its meaning, and in *ABL.* 791, which shows tribute from Dilmun (near or in the Persian Gulf, *AAA.* 1934, 101, 103) including 176 talents (about five tons) of *ŠIM.BI* . . . , and 26 talents of copper, it cannot be maintained that the heavy weight is likely to indicate cadmia or antimony rather than arsenic for *ŠIM.BI* . . . , since we do not know how much unnecessary earth may have been included. Tukulti-Ninurta brought eight mana of *ŠIM.ZI.DA* and

ten of *šadidu* from Hindana, above Anah on the Euphrates (*Ann.* 19), but there would not appear to be any form of collyrium native here, although it is noteworthy that the same king mentions a village *Šadidani* (i.e., 'of *šadidu*-kohl') between Hit and Anah (*ib.*). Sargon (*Gde. Ins.*, 183) includes *guhlu* in a general list of booty.

We have, therefore, to admit that we cannot define *ŠIM.BI.ZI.DA* with certainty, except to say that its synonyms show it to have been a general word for kohl, while on the other hand *MT.* and the tribute lists show that it was a special word used for an eye-drug (of some weight?); it is not until it receives the addition *SIG₇.SIG₇*, 'very yellow' in (*IM*). *ŠIM.BI.ZI.DA.SIG₇.SIG₇*, that it is definitely arsenic. This, by contrast, suggests that the probable special equivalence for simple *ŠIM.BI.ZI.DA* is stibnite or sulphide of antimony.

Šīpu and *lēru*, as specially the 'gold paint' and presumably 'black paint' respectively, will then be in their special uses arsenic in the form of realgar or orpiment for the former, and either antimony or, more probably, the natural arsenic for the latter, the Sumerian for this latter, *IM.ŠIM.TAK.SAĦAR*, 'the friable stone', coinciding with either. Stibnite, the most important ore of antimony, is found as fibrous or lamellar masses, which become dulled with a bluish or blackish tarnish on exposure, and the crystals are easily damaged, the mineral being quite soft (*WM.* 79). *PC.* ii, 404 describes native arsenic as being of a curved lamellar composition of a tin-white colour (steel-gray, turning black on exposure to the air, *ib.* 400), and *WM.* 68, that it is found in metalliferous veins together with ores of silver and cobalt: native antimony is also found in lamellar masses with a tin-white colour in metalliferous veins usually with ores of silver (*WM.*, *ib.*). The pictures given of native antimony and native arsenic on pl. 2 (*WM.*) are strikingly similar, and this may account for the confusion in Assyria. But, in general, *šīpu* and *lēru* appear to be general synonyms for a facial- or eye-paint of both realgar and orpiment, and the probability is, therefore, that *lēru* will be the natural arsenic in its special 'black' meaning.

Of the other synonyms, *egû* (*egû ša ekî*) would appear to be related to *ekû*, the ordinary word for applying a drug ext. (*PRSM.* 1924, 4). *Amamû* I cannot trace in other Semitic roots: *šimbizidû* is borrowed from Sumerian.

4 (r) *Damatu* (*da-ma-a-tu*, [*da*]-¹-*ma-tum*) = both realgar and orpiment. Perhaps from *dāmu* 'blood' (i.e. the reddish flesh-colour), or the Arab. *damma* 'smeared'. *Hurhura*[*tu*?], its equivalent, is uncertain, but perhaps the Heb. *hārar* 'be scorched' suggests a red colour. Meissner, *Beitr.* i, 47, quotes Radau, *BE.* xvii (1), No. 23, 19, 'As regards the *tabarru* (wool-stuff, or purple wool-stuff), about which my lord sent, I have not received the [*hurh*]urati from Bēl-usatum', and l. 29, 'although I have sought for [*h*]urhuratu in Dur-Kurigalzu, there is none:

let my lord send some [hu]rhurati'. Arsenic can, it is true, be used in dyeing, but we have gone some way from arsenic to reach *hurhuratu* as an equivalent of *damatu*.

4 (s) *Illur pâni* 'face bloom' refers to the colour of the Sumerian face (yellowish, see p. 32).

4 (t) *A-[d]u-mat*, for *IM.GÛN.NU*, the same word as *adumatu*, the red-brown sticks of opium (?) (*AH.* 42): cf. Heb. *adhmoné*, the ruddiness of Esau.

4 (u) *^aAS.ĤAR* is another of the arsenic group, equated with (*IM*).*ŠIM.BI.ZI.DA.SIG₇.SIG₇* (orpiment) and *Sin-kađrú*. I was perhaps wrong in *PRSM.* 1924, 24, in making *^aAS.ĤAR* the same word as *^aAŠ.MUR*. The two must surely be distinct, the latter, *^aAŠ.MUR* equivalent to the Egypt. *asmr*, *smri* (smiris, emery, smeriglio), as Boson had already suggested (see No. 30). The proof of this comes in the first place from 'J' 49-52, where *^aAŠ.MUR* is given the equivalences of *^aBALAG.GĀ* (pumice-stone) *^aZID.IM* (powder of clay), *^aZID.A.BĀR* (powder of lead), and *^aKÛ.BAL.E* (corundum, emery). As will be seen later *^aAŠ.MUR* and *^aAS.ĤAR* are both prescribed for eye-diseases, but they are apparently two distinct drugs: if *^aAŠ.MUR* had meant emery or corundum only, it would obviously be a gritty powder, quite useless for eyes, but from the above quotation it can clearly also mean 'powder of lead', collyrium, a very different matter, which allows us to accept *^aAŠ.MUR* as correctly read, from *σμυρίς*. The second piece of evidence, to show that the different form *^aAS.ĤAR* exists, comes from the pun in *KAR.* 71, 9-10 (trans. Ebeling, *MDAG.* v, 3, 31) *ana (?) -ku (?)¹ AS.ĤAR na-ša-ku ^aAS.ĤAR pa- . . . li-saĥ-ra bêl dabâbi-ia . . .* 'I hold *AS.ĤAR*, the mineral *AS.ĤAR* . . . , may it turn back my enemy . . .' where clearly the word *li-saĥ-ra* gives the clue to the correct pronunciation of *^aAS.ĤAR*.² Smiris and *saĥâru* show that we have two different words, *^aAŠ.MUR* and *^aAS.ĤAR*. But even so, the two may be confused even anciently, as is clear from a syllabary in Berlin containing equivalences similar to *AŠ.MUR*, copied by Herr Pick, from which, by the courtesy of Professor Ehelohlf, through Professor Langdon, I am permitted to quote the following group, similar to the preceding quoted from 'J', viz. (a) *AS* (not *AŠ*). *ĤAR*³ given as equivalent to (a) *^aLIŠ.A.BĀR*,⁴ (b) *^aKAK.A.BĀR*,⁵

¹ Or is it *ZID* 'powder'?

² Similar puns are to be found in *Maqlu*, V, 30 ff. *^aninî* and *linušu*, *^aazupîra-nitu* and *lišappîruši*, *^asiĥli* and *lišuluši*, *^asamedu* and *lišammuši*, *^akašî* and *liksuši*, &c.

³ *AS* is not quite clear, but it must be so from the traces.

⁴ 'Needle of Antimony', one of its common forms.

⁵ *KAK* has a value *sikkatu* 'peg' which may represent that form of the sulphide (stibnite) described by Spencer (*WM.* 79) 'the form of long prisms, varying from the thickness of a needle to an inch or more across'.

(c) ^aZID. A. BĀR,¹ (d) ^ami[r]-gi-ra-nu,² (e) ^a... KI.LI = ^a(blank), and (f) ^aŠI(ēnu) šā ri (?) ... = ^a,, kat (?). ...

In MT. ^aAS.ĤAR is prescribed: for eyes, in *himetu*-ghee (AM. 9, 1, 10, 12): as ZID. ZID (powder) to be applied (?) with others, AM. 19 6, 12: 50, 1, 3 (eyes?). Note ^aAS.ĤAR for eyes with 'growing (*alikam*) flesh', in *himetu*-ghee, alone (AM. 16, 1, 21), paralleled by nettle alone in honey (*ib.* 20), and cantharides with others (*ib.* 23). Sandaraca was prescribed in general for eyes, Pliny, NH. xxxiv, 55, but the parallelism of cantharides with ^aAS.ĤAR in Assyrian texts similarly dealing with growing flesh in eyes, rather suggests that arsenic is used with the idea of its destructive powers.³ In the same tablet (AM. 16, 1, 25) 'If a man's eyes are full of flesh and blood', cantharides is one of the drugs prescribed, the equivalent of the expressed moisture of 'wild beetles' which is to be applied by a *koḥl*-stick to the eyes in Syriac (SM. ii, 100), for a disease called *bar tōḥṭhā* ('son of a grape-cluster') or *gūglā*. The simile of 'grape-cluster' suggests contagious conjunctivitis (purulent ophthalmia): 'the state of the patient which is most likely to promote the development of the contagious form is that in which the conjunctiva is beset with the granular semi-transparent bodies, formed by aggregations of lymph-corpuscles, known as 'sago-grains' or follicular aggrega-

¹ 'Powder of lead'.

² ^aMirgirānu occurs Kū. iii, 1, 21 (if a man is sick of ŠI, 'gall') he is to drink ^ame-ir-gi-ra-nu ^aŠI (= *martu*) 'mergirānu and gall-plant' in beer: *ib.* ii, 69, ^ame-ir-gi-ra-nu ina 10 šiklu šihari ('one quarter of *mergirānu* in 10 shekels of beer' he shall drink) *ib.* ii, iii, 10, it occurs as variant for ^aararianu. The evidence which we have is that it is a drug used for 'gall' in medicine, equivalent to a word which represents antimony in various forms (needle, powder, and perhaps 'peg') and corundum and pumice, and, what may be of importance ^aēni šā ri(?) - ... 'eye of ...'. This last suggests the parallel ^aēni nūni (IGI.ĤA 'fish-eye'), a word 'fish-eye' having been taken to mean 'pearl' in a tablet found by Woolley at Ur, in which it represents tribute from Dilmun (A. T. Wilson, *The Persian Gulf*, 28). ^aIGI.ĤA occurs on KAR. 213, 2, with others 'for favour of Anu' (cf. also 21) and in a receipt to be worn with others KAR. 202, ii, 21: CT. xxxiii, 34, 29. Certainly the form *mergirānu* is comparable to the various words for 'pearl' in the Near East, *margarites*, Syr. *margānitha* (cf. *margolītha*) Pers. *merwerid*, Sanscr. *maracata*. Pearls were 'formerly considered as an invaluable medicine in stomach complaints' (King, *PSG.* 234), but particularly must we notice its use for bile (*IB.* 2046, where the method of dissolving is given). *BMM.* 106 says that the powder of the pearl is said to be highly stimulating, being used as an ingredient in prescriptions for heart disease, consumption, &c. There would therefore appear to be some probability of *mergirānu* being *margarita* 'pearl'. Its connexion with ^aAS.ĤAR, as powder, would appear in Pomet's description of the pearl (*HD.* 302) 'The Ladies of Quality use the fine ground Powder of it, to give a Lustre and Beauty to the Face. They make of it likewise, with Acids, &c., a Magistery and Salt ... but the best and only useful preparation of it, is the Powder well levigated'.

³ In SM. ii, 90 and 94 are two instances of arsenic ('yellow arsenic' and 'lamellar arsenic' [*si*]) prescribed in applications for eyes which appear to suggest only a mild ointment.

tions' (*DM.* i, 475), and the modern treatment prescribed is to touch the whole of the palpebral conjunctiva with a stick composed of one part of nitrate of silver fused with four parts of nitrate of potash (*ib.*). Cantharides has, of course, the power of blistering.

^aAS.ĤAR also for (cracked?) lips, with myrrh (*AM.* 23, 10, 7+26, 8, 9, *PRSM.* 1926, 63), with which cf. *SM.* ii, 668, green galls and arsenic for cracked lips. With *ŠIM.BI.ZI.DA* magically for success and plenty (*KAR.* 213, iv, 16).

Its equivalence with *Sin-ḫadrû* (or *eškadhrû*), as 'the bright yellow collyrium' suggests for the latter (if read *Sin-ḫadrû*) 'dull moon', i.e. the colour of orpiment, from Heb. *ḫādar* 'be dark, dull-coloured', of sun and moon (cf. the disease *Sin-lurmā* (*silurmā*)) prob. the origin of the Heb. *sanwērīm* 'blindness' (*PRSM.* 1926, 40).

AS.ĤAR is used as a simile for the mineral named ^aHU.LAĤ.ĤA: 'this mineral is like AS.ĤAR . . . this stone[']s name] is ^aHU.LAĤ. [ĤA] . . . the mineral unto the palace [gives entry?]' (*KAR.* 185, ii, 2). ^aHU.LAĤ.ĤA occurs *AM.* 90, 1, r. 5, to be brayed with four others (which are a form of cadmia, sulphate of iron, iron, and magnetic iron ore) to be anointed in cedar oil.

Before we give a definite meaning to this drug ^aAS.ĤAR (which is equated with orpiment, is called 'dull-moon-(colour)', not used internally, but for eyes and lips; in powder; and, in magic, to turn back an enemy (as poison?)); we had better consider first the next two forms of arsenic.

4 (v) Ašgikû, ašḫikû, inib karaši, ^aGURUN.GA.RAŠ.ŠAR (^aAŠ.GE₄.GE₄), a most interesting form, probably for native arsenic, with ^aMUĤ.AŠ.GE₄.GE₄, arsenious acid.

We have no connexion in the lists actually between this group and those minerals which we have taken to be realgar or orpiment, and hence our proof of its meaning lies in a different direction.

^aAŠ.GE₄.GE₄ (^aAŠ.GĪ.GĪ)¹ in one form or the other (with AŠ or AŠ), occurs in *MT.*: as *amulet* (or sim.), with ^aMUĤ.AŠ.GĪ.GĪ, &c., for 'the favour of the ruler (?)' *AM.* 7, 1, r. 6: as one of thirty-four 'against all evil, the Hand of the Ox' (*ŠIM.BI.ZI* being included) *KAR.* 213, 3, 19: as one of three for 'a kindly finger (to be pointed at the man)', *ib.* 4, 12: to be threaded and worn with others, including ^aMUĤ.AŠ.GĪ.GĪ, against hair falling out, *CT.* xxiii, 34, 30, cf. *KAR.* 202, ii, 21: on neck, *AM.* 46, 1, 25: 47, 3, r. 31. For ears, in cedar oil with myrrh, ^aZA.GĪN (carbonate of copper) and ^aSIG₇.SIG₇ ('very yellow mineral'), *AM.* 33, 1, 26. For eyes, *AM.* 85, 2, 7. Uncertain, *AM.* 29, 4, r. 6. *ZID.ZID* ^aAŠ.GE₄.GE₄ (powder) for 'muscle of the temples', *AM.* 19, 1, 6. Uncertain forms (for ears), . . . ^aAŠ.GE₄GE₄ with

¹ ^aAŠ.GE₄.GE₄? on *CT.* vi, 11, ii, 22, reading aš for at.

nikiḫtu (*liquidambar) in oil, *AM.* 37, 2, r. 8: with others (?), in cedar blood, *ib.* 4.¹

MT. is not definite, therefore, that this is arsenic, since, although arsenic is used for eyes (p. 53), it does not appear in *SM.* for ears (although for mouth and nose, ii, 187: *IB.* 1100). But two points in other evidence are valuable: *aAŠ.GE₄.GE₄* is once used in glass-making (Appendix I, Sect. S, and *OTC.* 44, 137, sect. S) (arsenious acid is used for glass): and in the plant-name *aAŠ*, *Asa foetida*, (*AH.* 265), we find a parallel, in that the garlic-like peculiarity of the latter appears to have led the Assyrians to indicate a form of arsenic (*aAŠ.GE₄.GE₄*) by the same syllable *AŠ* with *GE₄.GE₄* appended. 'Arsenic compounds, when heated on charcoal, give a white encrustation far from the assay, and at the same time fumes having a garlic odour are emitted' (*EM.* 284).

With some probability, therefore, we may for the moment connect *aAŠ.GĪ.GĪ* with a form of arsenic. We can next discuss the equation *aGURUN.GA.RAŠ.ŠAR* = *inib karaši* = *ašgikū* (v. [*aš*]*kikū*), 'A' 25: 'D' 16, placed in the lists after pyrites, green vitriol (decomposed pyrites), and the nodules of iron sulphide. *Ašgikū* certainly would appear to be a semitized form of *AŠ.GĪ.GĪ*, at all events at first sight.

Inib karaši is undoubtedly 'fruit (a grape-like form?) of *allium porrum*, leek'. As the Semitic equivalences stand, it can hardly be onion (*bišru*),² or garlic (*šūmu*), but 'fruit of leek', and must surely mean the bulb, which need not necessarily be described by the word *išdu* 'root'; actually *CT.* xix, 50, 13-15 indicates two values for the 'root':

13. *ŪR*(?). *GA.RAŠ.ŠAR* = *iš-di ka-ra-ši*

14. ? *GA.RAŠ.ŠAR* = *iš-di ka-ra-ši*

15. *NUMUN GA.RAŠ.ŠAR* = *zir ka-ra-ši*

1. 14 might, of course, be restored *NUMUN* 'seed'. Indeed, the phrase 'fruit of leek' almost suggests *allium cepa*, the 'bulb-bearing onion', which bears a crop of bulbs on the stalk. However this may be, there are two qualities which the species of the genus *allium* have in common, which have bearing on our theory for arsenic, viz. (1) the odour of garlic, which arsenic gives off when roasted (which has already been noted in connexion with the *AŠ* of *aAŠ.GE₄.GE₄* above), and (2) the laminated form of the bulb, which coincides with Pliny's 'scaly' of *arrhenicum* (*NH.* xxxiv, 56). Cf. *PC.* ii, 404 'Native arsenic . . . occurs massive, also in reticulated and stalactitic shapes, and of a curved lamellar composition, exceedingly like the layers of an onion. When fractured the new surface presents a metallic lustre, and a tin-white

¹ A seal can be made of it (1 *aḫunuk AŠ.GĪ.GĪ*, *ADD.* 993, i, 16, re-exd.). In *ABL.* 689 *aAŠ.GĪ.GĪ* occurs in a broken context.

² Is . . . *GA*(?). *RAŠ*(?). *ŠAR* = *bišru* (*Mat.* 86, 7-8, 29) to be restored from . . . *LAL.GA.RAŠ.ŠAR* = *bišru* (*CT.* xix, 50, 12)? Note a poultice of *inib GA.RAŠ.ŠAR* for stomach trouble (*Kū.* ii, iv, 30), probably in this case the vegetable.

colour.' Ar-Razi and Dioscorides (both quoted *IB.*, 1100) speak of the lamination of arsenic. GE_4 . GE_4 in aAŠ . GE_4 . GE_4 may represent this lamination of arsenic: $GE_4 = ekēmu$ 'to strip off' (*CT.* xii, 48, 46), *parāšum* 'to separate'¹ (Thureau-Dangin, *RA.*, 1912, 77, 1, 9): while $G\bar{I}$. $G\bar{I}$ of aAŠ . $G\bar{I}$. $G\bar{I}$ may have the simple meaning of 'one one'. To sum up aAŠ . GE_4 . GE_4 : the similarity of sound suggests the equivalence *ašgikū* (which is comparable to *allium*), and so, a mineral in laminated form, with a garlic odour (both properties characterizing arsenic): philologically we can compare the Arab. *šakk*, pl. *šukūk* 'arsenic' with *ašgikū* (*aššikū*). Moreover, the $AŠ$ of $AŠ$. GE_4 . GE_4 is comparable to the aAŠ -plant, *Asa foetida*, also with alliaceous smell: the use of aAŠ . GE_4 . GE_4 in glass-making again suggests arsenic: and in *MT.*, although the evidence is slight, we find it at least used for eyes. It should be noted, however (against *MT.*, *ext.*), that metallic arsenic is said to have no effect on the human system (*PC.* ii, 403), but cf. *EB.* s.v.

The inclusion of *ašgikū*, *aššikū* alongside pyrites in syllabaries suggests that the arsenical property of mispickel, arsenical pyrites may have been recognized. The evidence is thus very strong that aAŠ . GE_4 . GE_4 , *ašgikū*, is native arsenic.

From this we can go on to two other forms:

4 (w) *ZID*. *ZID* aAŠ . GE_4 . GE_4 , powder of arsenic, must surely be the suboxide, 'flypowder'; 'metallic arsenic usually becomes coated with a black layer of suboxide, and sometimes the whole falls to a black powder'. (*EC.* 243.) (Cf. (?) p. 48, *šindi šal[mi]*).

4 (x) aMUḤ . $AŠ$. GE_4 . GE_4 is lit. 'brain of arsenic' which, at first sight, suggests the white mass of sheeps' brains as exposed for sale in Eastern bazaars. Arsenious acid 'may be artificially prepared by heating the metal in atmospheric air, when, being very combustible, it burns and combines with oxygen; the white vapour of arsenious acid formed, speedily condenses' (*PC.* ii, 401). 'The commercial article is white, transparent and glassy when fresh, becoming milky and opaque by exposure' (*EC.* 244). Under the name of white alum, it is mentioned by the Greek alchemist Olympiodorus, who gives a receipt for its preparation from the sulphide by roasting in the air (*Coll.*, 67, 68: *TC.* i, 613). aMUḤ . $AŠ$. GE_4 . GE_4 is used in late times in decorating a gold crown along with aGIŠ . *ŠIR*. *GAL* (*NK.* 270, 37: *KB.* iii, 2, 119, 37: *VR.* 63, ii, 37), which suggests a yellow: so also does the comparison of aKA . *SIG*₇ 'yellow ochre': *abnu šāšu kima* aKA . *SIG*₇ *u sadi[rīšu]* . . . *abnu šuatu* aMUḤ (surely thus, and not *KA*). $AŠ$. GE_4 . GE_4 (*KAR.* 185, r. ii, 9). Either there is a confusion between the various forms of arsenic, or, more probably, something similar to the modern 'King's Yellow' (a

¹ Not necessarily instead of *parāsu*: *parīštu*, *CT.* xxiii, 42, 17, is 'a separated woman'.

mixture of arsenious acid and orpiment) was produced, or, in the latter case, there is a reference to the yellowish colour of the mass of arsenious acid when recently broken (PC. ii, 401). [^a]MUḤ.AŠ.GE₄.GE₄ occurs, GE. ix, vi, 32: for use in MT. see ^aAS.GE₄.GE₄. There is a longer form ^aMUḤ.AŠ.GĪ.GĪ (read thus for ḤU) *di-gi-li* used by Sargon (Oppert, *Gde. Ins.*, 142), probably as a paint, the *digili* perhaps being comparable to the Arab. *dajala* 'smear on tar', and even (in II) 'gild', presuming that it has nothing to do with eye-sight, as collyrium.

To sum up: there is a long series of words, compounded with GUŠKIN 'gold' and SIG₇ 'yellow', which may be identified with the sulphides of arsenic, realgar, and orpiment, respectively, having various definitions such as 'gold paint', *šīpu, lēru, damatu* ('blood colour'), *kalû* (yellow ochre), *šaršeru* (rouge), *illur pâni* ('face bloom'), &c. (see p. 46). Natural arsenic appears to be ^aAS.GE₄.GE₄ or ^aAS.GĪ.GĪ, made up (a) of a base AS, which is the same as the ^aAS 'asa foetida', which, like arsenic when roasted, has an alliaceous smell, the same similarity being obviously indicated in the synonym *inûb karaši* 'fruit of leek', with its lamellar composition, and garlic-smell: and (b) of the characters GE₄.GE₄ or GĪ.GĪ, both of which suggest the lamellar constitution of natural arsenic: ZID.ZID.^aAS.GE₄.GE₄ is probably the black 'fly-powder'. It is expanded into ^aMUḤ.AŠ.GE₄.GE₄ 'brain of arsenic', i.e. the white mass of arsenious acid, sublimated from the natural mineral (used in some way for gilding). ^aAS.ḤAR (definitely ^aAS.ḤAR, although there may be a confusion between ^aAS.ḤAR and ^aAS.MUR, No. 4 (u)) is equated with 'orpiment', and from a synonym, *Sin-ḳadrû*, would appear to be of a dull yellow, and is used for eyes, and not internally: certain equivalences, such as ^aLIS.A.BAR (see No. 12, (a) 1 (d)) 'needles of antimony', rather suggest a similarity with the lamellar natural grey arsenic, as against the yellow orpiment, which make an exacter definition for this last difficult.

5-13. THE METALS

5. Gold. 6. Silver. 7. Copper. 8-11. Iron. 12. Lead (and antimony). 13. Tin (and lead).

- 5 (a) *Ḥurašu*, *GUŠKIN*, gold.
- 5 (b) *Šariru*, *AN.TA.ŠUR.RA*, red gold.
- 5 (c) *Pašallu*, gold leaf(?).
- 5 (d) *Zaḥalû*, gold leaf(?), overlay(?), or perhaps electrum.
- 5 (e) Other forms.

5. GOLD

5 (a) *Ḥurašu*, *GUŠKIN*, gold.

GUŠKIN, i.e. *KÛ.GI*. which may perhaps be 'the heavy bright' metal, if we may compare the *GI* in *^aKA.GI.NA*, haematite; *ḥurašu* has long been compared to the Heb. *ḥârûš*, and the Greek χρυσός, probably from a root *ḥarâšu* 'be yellow', Syr. *ḥ'ra*. Perhaps one of the earliest occurrences of the word is to be seen on the (almost picture) tablet in Barton, *UMBS.* ix, 1, iii, 4 (see Langdon, *Pictogr. Inscr.*, No. 264), but from the discoveries in the Royal Tombs at Ur gold working must have been begun long before the end of the fourth millennium, before we have any record of the word in writing.

Gold was found in Aralu (perhaps intended for humour, 'Hades, the Underworld', ii R. 51, i-ii, 11: cf. *ḥurašu binut ZU.AB, KAH.* 75, 25: and see 5 (b), *šariru*): gold dust was brought from Ḥaḥu (Gudea, *ISA.* III, 33, according to Sidney Smith, *EHA.* 99, it = Cilicia): according to Hittite sources, from Birundummeia (*KS.* iv, 80; *KTb.* iv, 1, and *KUBD.* 2, 35). Tushratta of Mitanni asks Egypt for more gold (*TA.* No. 1): Tigl. Pil. III (745-727 B.C.), describes Šikraki in Media as 'of gold' (*ša ḥuraši*, ii R. 67, 32): in Persian times gold came from Saparda (Sardis, the Pactolus), Scheil (*MMAP.* xxi, 8): nowadays from N. and NE. Armenia (but sparsely); between Van and Urmia, G., fig. 8; from N. Persia; and from Yemen in Arabia (*G.* 67, 69, 53: Mactear, *TIMM.* 1894, 26: and Schoff, *Periplus*, 160, quotes Glaser (*Skizze*) as having located ten Arabian goldfields); and the Sudan.

The ancient method of mining gold is described in *AEMI.* 186: in the case of alluvial gold, the sand or gravel was washed in running water which carried off the lighter material, leaving the heavier gold. Agatharchides (*ib.*) says that in Egypt in the gold mines the quartz was broken up with fire, and then by hand, and the detached rock then crushed in mortars to the size of peas, and ground to fine powder in mills, the powder then being washed. I have myself seen numerous ancient handmills lying about near the mines at Gabêt in the Sudan, great stones, as much as a man can lift, showing in the upper part the traces

of circular grinding (*Man*, 1908, 36). (Cf. also Gowland, *Journ. Anthr. Inst.*, 1912, pl. xxvii).

The two colours of gold are given as *GUŠKIN.ḤUŠ.A* (red gold) and *GUŠKIN.SIG₇* (yellow gold) in a charm against the wrath of a man's god and goddess (*KAR.* 213, i, 15).

The former occurs in the reign of Shulgi (Scheil, *RA.* 1920, 212), and Ibi-Sin (Legrain, *RA.* 1933, 123), and is common in later historical texts: in *MT.*, in rituals, *AM.* 17, 2, 4: 71, 1, 19: 90, 1, 5: 91, 4, 3. *GUŠKIN.SIG₇* is comparable to the *arḫu* 'yellow' of 'U' 12. (For a shekel *pitka ḥuraši*, see *Nbn.* 195, 1: for a wedge, *lišanu*, *ib.*, 331: *S.* 1341, Bezold, *Cat.*, 1480).

The Assyrian chemists appeared to know the effect of an infinitesimal amount of gold used in glass making, to make coral (i.e. red coral, doubtless ruby-glass), the same as the Purple of Cassius, which was not supposed to have been discovered until far into our era (see Appendix i, Sect. DD: *OTC.* 32). This, of course, suggests a knowledge of *aqua regia* (see Introduction).

5 (b) Šariru, AN.TA.ŠUR.RA, red gold.

Cf. *GUŠKIN.ḤUŠ.A* above. *Šariru* = 'gold', 'U' 17 and 'W' 13. *Šariru ruššū* 'red šariru' is described as *nabnit Aralli epir šaddišu* ('the produce of the Underworld, the dust of its mountain' *K.* 2801, r. 36, Meissner-Rost, *BA.* iii, 295 ff.: cf. *KAH.* 75, r. 14). It may, however, be distinct from *ḥurašu*: cf. ii *R.* 58, d, 66-7, (*šarpa ḥurašu šariru*). A ring is made of it (*unḫi šariri* (!), iv *R.* 26, 7, 38-9), and it is used from Sargon's time onwards in offerings (*Khors.* 167), to make *lahmē-colossi* (Esarh., *KAH.* 75, 24); booty from Elam, aforesaid captured by the latter in Babylonia (Ashurb. vi, 11, and used for decorating chariots, *ib.* 23); used by Nebuchadnezzar for the ship of Marduk (*EIH.* i *R.* 53 ff. iii, 10). In incantations, *CT.* xvii, 39, 50: iv *R.* 18, 46, b.

5 (c) Pašallu, gold leaf (?).

'U' 15 = gold. Possibly akin to Syr. *p'šāllā*, textura. Senn. speaks of pillars with an overlay (*iḫzit*) of *p.* and silver (*CT.* xxvi, 39, vi, 37), and a couch clothed (*litbušat*) in *p.* (*BS.* 36), and Asb. of a couch (Cyl. C, x, 38). Cf. *umallū pašallu ša ḥabbilu* . . . (Meissner, *ZA.* 1895, 18, 249). Are we to consider here: $\frac{1}{3}$ *mana ḥuraši bašalam*, *TTC.* 71: and the Cappadocian $\frac{2}{3}$ *manam ḥurašam pā-ša-lam ša ḥa-ra-an a-lim* (*CC.* 19, 3): *1 manam pā-ša-lam* (*ib.* 30, 30): and particularly $\frac{1}{2}$ *manam kašpam pā-ša-lam* (*ib.* 22, 31)? Since it is used in the Cappadocian texts as an adjective to both gold and silver, this, coupled with its Assyrian use as an overlay, suggests the meaning 'overlay', which the

later synonym 'gold' would allow us to presume indicates 'gold-leaf'. Layard found thin gold leaf on ivories and bricks and under a great throne or altar at Nimroud (*Nin.* ii, 417).

5 (d) *Zaḥalû*, gold leaf (?), overlay (?), or perhaps electrum.

Tigl. Pil. III (eighth century) sheathed doors of cedar and cypress with *zaḥalû* and *ib-bi* (ii. R. 67, 79). Senn., after casting colossi of *erû* (bronze) with clay moulds, like half-shekel pieces (see p. 62), says 'colossi created of bronze, of which two were clothed with *zaḥalû*' (King, *CT.* xxvi, vii, 20). Esarh. adorns the shrine of Ashur, which his ancestors had made of burnt brick and adorned with *zaḥalû*,¹ with 180 talents (nearly 5 tons) of *išmarû* (*KAH.* i, 75, r. 2). In the time of Asb. the weights are given: e.g. 50 *bilti zaḥalû ibbu agurri aptik-ma* 'I made 50 talents of shining *zaḥalû* for (?) burnt brick' (Cyl. C, x. 24) and 'the shrine of Sin, my lord, with 70 talents of *zaḥalû ibbu u[labbiš]*' (Streck, *Asb.* 172, 32). He carries off from Egypt two obelisks cast (*pitik*) in (of) *zaḥalû ibbi* of 2500 talents weight (something less than 70 tons) which may be either solid, or merely overlaid with electrum on stone (Rassam Cyl. ii, 41). Nbk. (*EIH.-Ins.* iii, 60 (i R. 53 ff.)) makes the bulls at the gates shine brightly with *zaḥalû*, and Nbn. makes his colossi of the same (v R. 64, 14, b).

It is thus a material (a) for coating wood, bricks, and bronze colossi: (b) connected with obelisks. There have been several suggestions; *BS.* 35, adducing the throne from Nimroud covered with bronze overlay (*Nin. and Bab.*, 198), suggest orichalcum (but also 'Rotgold', *ib.* 15): cf. *MA.* 277, comparing Eth. *zaḥala*, aeruginavit. But surely bronze colossi will be coated with something more valuable than orichalcum, and again, it is noticeable that gold leaf (as has been already mentioned in 5 (c)) was found by Layard in the NW. palace (*Nin.* ii, 417). Orichalcum is prop. brass (7 (h)), and we already have *elmešu* for this, never given in connexion with *zaḥalû* in the lists. In Egypt electrum was used for coating wooden objects, such as furniture and sarcophagi: gold was largely employed for gilding objects, generally wood, but occasionally bronze, and even stone (*AEM.* 86, 93). It cannot, however, be said that there is anything very definite on which we can rely to settle the exact meaning of (or difference between) *pašallu* and *zaḥalû*. *Ibbu*, for instance, suggests electrum (which was a natural alloy with a light colour, passing as silver when the silver content is high, *AEM.* 84). Cf. the λευκὸς χρυσός of the Lydian coins (*Herod.* i. 50). Abp. apparently overlays wood with an alloy of [AN].NA and red gold (see No. 13).

¹ Translation uncertain, owing to a break: it might be 'which the kings my fathers had built of burnt brick, *zaḥalû* its sheathing with 180 talents of *išmarû* I caused to make'.

5 (e) Other forms and synonyms of gold.

(1) *Šaššu*, 'U' 11: 'W' 10. Formerly translated 'white marble' (Heb. *šaiš*, Pinches, *MA*. s.v.): Meissner (*Beitr.* ii. 67), connects the alchemists' value 'gold' for Syr. *šamša* 'sun': 'with *tiri šašši u abni* an overlay of gold and stones' I clothed (*NK.* 128, 6: cf. *ib.* 158, 30): *pāš šašši*, a golden axe (*KAR.* 168, iii, 37). Meissner quotes ii. R. 67, 83, *aṭman šašši nisiḫti abné*, a building of gold and precious stones. Scheil (*MMAP.* xxiii, 141) uncertain: 4 *zumbu gadu taktimišunu 2 taritu u šaššu TAB. BA.* (2) *Arku*, 'U' 12, i.e. the 'green-yellow'. (3) *Zūzu*, 'U' 13: 'V' 10. Johns (*ADD.* ii, 290) compared Syr. *zūz*, a coin. (4) *Ligtu*, 'U' 14, probably Syr. *laggethā*, patina, lanx (cf. *zallhu*, below). Tukulti-Ninurta took ten manas of *huraši li-ig-tu* from Hindana (middle Euphrates (Scheil, *Annales*, 18, 76)). (5) *Šaidu*, 'U' 16, from *šādu*, to shine. (6) *Magū*, 'U' 18. (7) *Misu*, 'U' 19: 'V' 3. (8) *Dalbu*, 'U' 20: 'V' 4. (9) *Daialum*, 'V' 5. (10) *Anaku*, 'V' 7: possibly, as Johns thought (*ib.*) connected with lead (from its weight?). (11) *ŠAL.LA*, 'V' 9. Probably no connexion with *multaspū* (No. 72). (12) *Zallhu*, 'V' 11 = 'gold in Shubarti', with which Johns (*ib.*) compared Syr. *z'liḫē*, patinae, with which the next coincides well. (13) *Airaḫi* 'V' 12 = 'gold in Shubarti', connected with *arḫu* 'scale' (as in copper, No. 7 (b)) (not to be emended to *zaraḫi*, as Johns, *ib.*). (14) *Sāmu*, 'W' 11, lit. 'the red'. Sargon receives *sāmu ruššū* 'ruddy red', as tribute from the Temple of Ḫaldia (*HC.* 59, 371): Clay, *UMBS.* ii, 2, No. 110 mentions *hurašu sāmu*: probably also *AM.* 17, 2, 4 (*sa-a . . .*). (15) *Sakēru*, 'W' 12, probably the *hurašu sagiru* of *HC.* 58, n.⁴, where Thureau-Dangin explains it as identical with *sagru*, comparing Sargon, *Ann.* xiv, 42: *HLB.* 114, 18-19: *ADD.* 233, r. 6: 260, edge 3: 1141, 41: *OLZ.* 1905, 131, 21. The comparison with the Heb. *zāhābh s'gór* was made long ago (*MA.* 758), but 'shut up', and so, 'rare', can hardly stand. With so many references to 'red', cf. Syr. *s'kar*, *rubrum fecit*.¹ (16) *GUŠKIN.ŠAR.DA* 'with alloy', 3rd dyn. of Ur (Legrain, *RA.* 1933, 125). (17) *GUŠKIN.SI.SÁ* (*ib.*: 'rectifié', Shulgi, Scheil, *RA.* 1920, 211). (18) *Ḫurašu šadī* 'mountain gold', *Nbk.* 280, 6.

6. SILVER

6. Kaspu, KUBABBAR, šarpu, silver.

KUBABBAR = 'white brilliance'. It came from *Šaršu* (ii R. 51, 10): 'the mountains' (Gudea, *ISA.* 157, xvi, 21): Sargon of Agade

¹ It may be worth suggesting that some of the words on the above list have the appearance of slang: 'the red', 'the yellow', 'the shiner', 'the circulator' (*daiālu*), 'lead, tin', for which our 'yellow-boys', 'shiners', 'ready' (for money), and 'tin' (used in England at various times when gold was in circulation) suggest themselves.

says '[Enlil] gave him the upper land, Mari, Yarmuti, Ibla, as far as the cedar forest and the silver mountains' (Poebel, *UMBS.* iv, 1, 178), which must be the silver mines of Keban Ma'den: Shalmaneser III speaks of 'Tunni, the mountains of silver, Mulî the mountains of alabaster' (*KAH.* 30, iii, 2): Sargon II brought it from Mušasir (N. of Assyria, *HC.* 352). Manishtushu carries his rapine 'as far as the silver mines' (*hûri Kû*) (Poebel, *ib.* 206.). In Persian times it came from Egypt (Scheil, *MMAP.* xxi, 8, 28). It is found to-day in the mountains S. of the Black Sea (*G.* 67-9): the mines of Keban Ma'den (argentiferous galena, botryoidal corneous silver, white carbonate of lead, sulphate of copper, arseniate of lead, diallage, serpentine, *A.* 19, 279): and Denek Ma'den (*Tr.* i, 153). 'Eventually' (*AEMI.* 206) 'silver was obtained from argentiferous lead ores.' Lucas (*ib.* 205), thinks that in Egypt and W. Asia there were alloys of gold and silver, so rich in silver as to be silver-white, and it was these alloys which constituted the first ancient silver. (For analyses of early Babylonian silver see *UE.* ii, 293.)

The word *KUBABBAR* occurs on a pre-Sargonic tablet (*HRET.* 12, No. 2). The silver vase of Entemena is said in its inscription to be made of *KÛ.LAH.ĦA* (Heuzey, *RA.* 1897, 35). $\frac{1}{3}$ (mana) of *KÛ.LAH.ĦA* mentioned (Shuruppak, Thureau-Dangin, *RA.* 1907, 149, cf. 142). Cf. *TDT.* 1091, &c. Johns (*ADD.* ii, 277) quotes the common epithet of silver, *LAĦ. misû*, lit. 'washed', as probably 'refined', but exactly what the process (or meaning) was we cannot say, but see Copper, No. 7 (c). Silver in pieces (ore) *kaspi šibirti* (cf. copper, 7 (a), and under the iron oxides, 8 (b), 1. 10, *LAGAB.KA.GI.NA*) (Budge, *ZA.* iii, 1888, 220, 25). *Kalû* 'roasted' is applied to silver in late Bab. times (Dhorme, *RA.* 1928, 55, 67). *Šarpu* comes from the verb *šarâpu*, in ii, 1, 'refine': *kima šarpi šurrupi* 'like refined silver (may he be bright)' iv *R.* 4, iii, 40-41, and this adjective is used in Cappadocia, *kaspu zarubam* ($1\frac{2}{3}$ mana, 6 shekels), *TTC.* 71.¹

Ginnu (Johns, *ib.* 'standardized', following *HWB.* 'normiert') occurs as an epithet of silver (late Assyrian, *ADD.* 612 and subsequently late Babylonian): *11½ šiklu kaspi ša ginni* (*Dar.* 117, 1): *12 mana kaspi ša ginu ša nadanu u maḥari* (*ib.* 134, 1: cf. 147, 2: 170, 2): *12 (?) šiklu kaspi ša ginnu ša ina 1 šiklu pitka* (*ib.* 294, 1) *15 šiklu kaspi ša ginnu ša nadanu u maḥari* (*ib.* 334, 1): *2 mana kaspu pišû(u) nuḥḥutu ina 1 šiklu pitka ša la ginnu* (*ib.* 334, 1), and for *la ginnu*, *2 mana 3 šiklu kaspu pišû ša ina šiklu pitka nuḥḥutu la ginnu* (*ib.* 333, 1): *2 mana kaspu pišû nuḥḥutu ina 1 šiklu ša la ginnu* (*ib.* 411, 1). (See Hrozný, *BA.* 1902, 546.)

On the possibility of certain roundels being coins, see S. Smith, *A Pre-Greek Coinage in the Near East?* (*Numismatic Chron.*, Fifth Series, ii, 2-11: *Early Hist.*, 395). There is no doubt that in the time

¹ Add, as uncertain, *KUBABBAR.ME.A* = *kaspu(?)* . . . and *šip-pa* . . . (Langdon, *RA.* 1917, 77).

of Sennacherib (705-680 B.C.) half-shekel pieces were cast: King (CT. xxvi, 25, 16): 'according to the command of the god, I fashioned moulds (*zi'pi*) of clay, and poured bronze (*erā*) therein, as in casting half-shekel pieces (*kī pitik* $\frac{1}{2}$ *šiklu-ta-a-an*)'; for the possibilities in the late Bab. contracts for one-shekel pieces, see Introd. § 9. On *istatir-ramu* as 'stater' see ADD. ii, 285 (time of Antiochus iii): *istatirri*¹ of Alexander, Clay, *Legal Doc.*, 35, No. 84.

7. COPPER

- 7 (a) *Erā*, URUDU; *siparru*, ZABAR; copper and bronze.
- 7 (b) (1) URUDU.ZA.Rī.IN, *zarimu*, *ķurnu*, probably orichalcum.
- 7 (b) (2) *Siparru* (*erā*) *arhu*, copper scale, copper oxide.
- 7 (c) *Mesū*, URUDU.ĦU.LAĦ.ĦA, 'washed' copper.
- 7 (d) *Ħil erā*, A.DAN.URUDU, 'gum of copper', probably Pliny's chrysocolia.
- 7 (e) *Šuhtu*, ZABAR, DUB, EMEDUB, verdigris.
- 7 (f) *Tuskū*, *tuškū* (SÜ.ĦĒ?), spodos, oxide of zinc.
- 7 (g) *Lulā*, *lulūtu*, KÜ.ĦĒ; (*luludanitu*) pompholyx, oxide of zinc.
- 7 (h) *Elmešu*, *elmušu*, SÜ.UD.ĀG.(GĀ) brass.
- 7 (i) *Erū BE ša kaḳḳaru ikkal-šu*, ZID.URUDU.NI.KÜ.E, 'Roast' (or, improbably, 'old') 'copper which the earth has eaten', 'dust of copper eaten' (tutty, or *aes ustum*?).
- 7 (j) URUDU.A.EN.DA, ?

7 (a) *Erū*, URUDU; *siparru*, ZABAR; copper and bronze.

Originally *erū* was 'copper' and *siparru* 'bronze', but *siparru* has become copper by the time of Sargon II (HC. 57, quoting Winckler, AOF. i, 160, and 548), objects such as daggers, lances, and bows being *erū* (HC. 62, 63).¹ Native copper was called URUDU.SAĦAR.ĦU.LAĦ.ĦA (= 'copper + dust + washed') = *ši-it hur-ri*, 'what comes out of the mine' ('S' 28: Langdon, RA. 1917, 77) (see URUDU.ĦU.LAĦ.ĦA, 7 (c)). Cf. Pomet: 'Copper is taken out of the Mine in Sand, and in a Stone, almost like that of Iron; and after it is wash'd and purified from the Earth mixt with it, it is cast into Moulds' (HD. 336). Another word apparently for copper in the raw is *siparru šibirtu* (3600 talents, 'morceau (non façonné)'), Thureau-Dangin, HC. 369, comparing ZA. xvi, 362, n. 2, and JA. 1908, 123, n. 6: in an omen 'When KÜ.PAD.DU *siparri* . . .' (CT. xxxviii, 9, 6: l. 5 gives 'When KÜ.PAD.DU (i.e. *šibirtu*) UŠ . . .'), following one for A.GÜG 'lead': cf. *kaspi šibirti* (No. 6). URUDU.SAĦAR.LAL (= ŠU-ku, i.e. *millaku*?, 'S' 29) since LAL has the general sense of 'binding' suggests 'bound copper dust', a natural lump, ingot? Similarly URUDU.SAĦAR.KI and URUDU.SAĦAR.ŠU, both = *la'šu*, the Syr. *laisā*, massa, must be the same (ib. 30, 31), and probably

¹ For URUDU, copper, about the middle of the third millennium B.C., see Contenau, RA. 1915, 15-20: ITT. 6700: on copper as a method of payment, Thureau-Dangin, RA. 1907, 148.

URUDU.TIL.LA, 'living copper', one third of a mana (Scheil, *RA.* 1921, 51, 17). *URUDU.(G)IRA* 'male copper' occurs *MT.*, *AM.* 7, 1, 10: 12, 4, 4: and in an amulet *KAR.* 213, ii, 19, 20. *ZABAR ruššú* 'red copper' was the material of four (statues) of *GUD*, son of Shamash, made by Senn. (*Luck.*, 145, 18: *KAVI.* 74, 7: *KAH.* ii, 124, 18) and a drum (*Luck.* 149, 9). Of uncertain meaning are *eram watram* and *eram maziam* (Cappadocian, *CC.* 1, 5 and 7). On *erū šipku* and *šapku* see *HC.* 400 and 403 ('coulé'). 'The first product of the primitive smelting of copper ore was a spongy mass of metal, incompletely fused and containing extraneous matter; this was hammered with stone, to liberate the cinders and bits of unreduced ore, thereby obtaining a lump of impure metal, which, as was learned ultimately, could be refined by being returned to the fire and re-melted' (*MAM.* i, 116).¹

AEMI. 169 describes the method probably adopted by the ancient smelters in Egypt. The ore, after extraction by flint tools, was probably crushed, hand-picked, and then smelted, being mixed with charcoal, in a heap on the ground or in a shallow pit, to which a simple form of forced draught was applied. In Persia, in the country districts, where copper is plentiful (Mactear, *TIM.* iii, 1894, 21) in the case of the sulphide ores, after hand-dressing, the ore is roasted in a mud furnace which forms a cone of about 7 feet in height, in which are air-holes. At the bottom is an opening closed with a door, through which the ore can be drawn and the draught regulated, about 35 per cent. of fuel being required. The smelting is carried out in a small blast furnace (about 18 in. depth and 9 in. diameter (*ib.* 24)). Note also, *YT.* 103: 'the workmen [at Arghana Ma'den] . . . scrape about among the old workings till they can fill a basket with ore, which is then roasted in the open air, and smelted to a very impure "black copper"'. Copper came in ancient times from Magan (ii *R.* 51, iii-iv, 17: see Lenormant, *TSBA.* 1878, 347): ten manas from Magan (*ITT.* ii, 2864, p. 3), with reason identified with Oman and the Arabian side of the Persian Gulf (see Langdon, *CAH.* i, 416), borne out to a certain extent by Peake, who pointed out that analyses of samples of copper ore from Anatolia, Persia, Cyprus, and Sinai, which contain no nickel, eliminate these localities as possible sites for Magan (since nickel is one of the usual components of Sumerian copper), while at Jabal al-Ma'dan in Oman, inland from Sohar, old copper workings are still to be seen, and the ore of these mines 'much mixed with other minerals' does actually contain 0.19 per cent. nickel (*Antiquity*, 1924, 452). It is, as he says, a curious coincidence (probably not of any great value) that about 35 miles SE. of Jabal al-Ma'dan is a village called Makanyat. This,

¹ At what point does *erū* become *erū dannu* 'strong copper', 'S' 24? For *URUDU.NIG.KALAG.GA* as 'bell' see Gurney, *AAA.* xxii, 1935, 85 (cf. Dhorme, *RA.* 1911, 60).

however, is somewhat discounted by Dr. John Evans having later reported copper ores containing nickel and manganese from Sinai (*UE.* ii, 287). The adjectives applied to copper, *Makannû*, *Dilmunû* (cf. *ABL.* No. 458), *Meluḥḥû* (see 'S' 32 ff.) certainly press the claim of the Persian Gulf as the chief provenance for Sumer. The Cappadocians in the north drew it from Ḥaburata (*erum Ḥaburataium*, and cf. *erum Tišmurnaium*, *KK.* 5, 10), and in the Hittite texts *URUDU.ZABAR*¹ came from Alašia (Cyprus, *KS.* iv, 80, 39-40). Even Gudea brought it from the mountains of Kimash, supposed to be N. of Assyria (*ISA.* 111, 22), not improbably the mines of Arghana Ma'den (copper, copper pyrites, asbestos, jasper, calc-spar, *EE.* ii, 355: *Narr.* 523: *A.* 273: *YT.* 86: W. W. Smyth, *Quart. Journ. Geol. Soc.* 1845, 334) (Layard notes it at Tiyyari in the Valley of the Zab (*Nin.* i, 223)).

Among the analyses of copper objects as made by Dr. C. H. Desch (Scheil, *RA.* 1930, 188)² are: a dated Susian copper axe (Adda-Bakšu, contemporary of Sumu-abi), before corrosion, as he suggests, 96.60 per cent. copper, 0.45 per cent. nickel, 2.90 per cent. iron: a hoe, from its inscription perhaps older than the preceding, 98.5 per cent. copper, 0.12 per cent. nickel, 1.34 per cent. iron. An axe, also from Susa, analysed by Dr. Desch (see Contenau, *Manuel*, i, 56), was 99.12 per cent. pure copper, and similarly the core of a dagger (?) from Eridu, analysed by Dr. A. Scott and Mr. Padgham was 99.4 per cent. (*Arch.* 1919, 144).

The earliest settlements in Mesopotamia appear to have been without copper (Ur, Erech, Al-'Ubaid, *MAE.* 141: Nineveh, *AAA.* xx, 1933, 145; only five pieces of metal altogether found at Arpachiyah, *Iraq*, 1935, 24). At Ur a spear head occurred just above the 'Flood' deposit, practically of pure copper; and thereafter, in the Jemdet Nasr period, copper bowls are fairly numerous (Woolley, *A.J.* 1934, 369). At Nineveh a small piece came from the bottom of No. 3 stratum, with about 20 feet of occupation-debris below it. Much time must surely have elapsed between the first primitive working and the rich amount and skill shown in the *IM.DUGUD* stele found by Hall at Al-'Ubaid (not later than, let us say, 3000 B.C.; cf. *HMU.* 40): at Nineveh, for instance, was a hiatus of 30 feet between the lowest piece of copper found and the next later (depth *MM.* 27), almost pure, with 1 per cent. iron, a tanged lancehead, corresponding to the Jemdet Nasr period.³

But the use of tin in making bronze has given rise to various theories about early Sumerian connexions with other centres. Plenderleith

¹ Cf. *URUDU.ZABAR*, *ITT.* 6700.

² For earlier analyses of De Sarzec's copper, *v. HS.* i, 391.

³ 'We have reason to believe that fully two millenniums separated the first use of hammered copper from the beginning of true metal culture' (*MAM.* i, 109).

explains (*UE. ii*, 288) that the ores of copper and tin do not usually occur together, and consequently we have to seek for the provenance of Sumerian tin elsewhere than where copper is found. He quotes Dr. Rickard's theory that the ores were not smelted at Ur, but that the metal came from the Caucasian Highlands, a view maintained by Frankfort (*AY. 1928*, 233), who considers that the Sumerians before 3000 B.C. were in close touch with an important centre of metallurgy somewhere south of the Caucasus. Whether this was so after the discovery of bronze is problematic: but the evidence from Nineveh and Arpachiyah seems to show that, until the introduction of tin, this was unlikely. It would be a curious thing if the Sumerians, those masters in copper-working, had been able to tap the resources of the distant north in prehistoric times, while Nineveh and Arpachiyah, much nearer, had no such metal-working association. It should be noted, however, that zinc and tin are found in Persia in the Kuh-i-Benan (*G. 69*), and farther NW.: Childe (*MAE. 187*) suggests that Drangiana, mentioned by Strabo, was probable for tin, and Gowland speaks of the ancient tin workings in Khorassan (*Journ. Anthr. Inst.*, 1912, 252). Wainwright (*YEA. 1934*, 29-32), shows that a likely source of tin and bronze was the Kasrwan district of Syria (NW. of Beyrout), where both tin and copper occur (quoted *AEMI. 213*).

Bronze is consequently our next consideration. We have already noticed the confusion between *erū* and *siparru*, and in this connexion must be mentioned the inexact use of other words, such as *anaku*, tin, but sometimes lead, and *abaru*, lead, but as *LIŠ. A. BĀR* 'needles of lead', antimony. In point of fact there is no proper word for tin, and we find Dr. Rickard suggesting that it is uncertain whether the Babylonian ever smelted the ore for bronze at all at Ur, where there are no mineral resources, and that, as the variability of tin in Babylonian bronze is so great, it may have been accidental (quoted *UE. ii*, 288). But Dr. Constance Elam (*ib.*) will not agree: 'traces of tin might be inadvertent, but scarcely as much as 11 per cent'. Plenderleith (*ib.*) goes on to say that 'to obtain results by the smelting of a mixed ore which could in any way compare with those obtained at Ur, it would be necessary that the ore should be mainly copper in an oxidized form such as malachite containing widely varying amounts of tin, more than a trace of nickel, variable small quantities of lead and iron, but no sulphur, phosphorus, &c.; that such a mixed ore was available in quantity to the Sumerians or ever existed in the East is at present entirely a matter of speculation'.

What is important to notice is that Plenderleith (*UE. ii*, 285) says that the artifacts of the Royal Cemetery of Ur ('c. 3500-3200 B.C.') show undoubted incrustations of tin-bronze, but that about 2700 B.C. a period set in when bronze began to be used less frequently. Since bronze, as he says, was much easier to cast than copper, he suggests that the

reason for this change may have been that the supplies of ore ran out, or that the supply of tin was cut off (cf. also *MAE.* 187).

The proportions of copper to tin are given by *Nbn.* 471 as $\frac{1}{2}$ talent, 5 manas, $\frac{1}{3}$ shekel of copper to 4 manas, 5 shekels of tin (i.e. about $8\frac{1}{2}$ to 1), for making bronze, which is almost exactly the bronze from Nimroud (9th cent., *Nin. and Bab.* 670):

Copper . . .	89.51	89.85	88.37
Tin . . .	10.63	9.78	11.33

and not far different from that of the Royal Cemetery, Ur (*UE.* ii, 290):

Copper . . .	84.18	85.13	85.01
Tin . . .	12	11.78	14.52
Nickel . . .	2.2	0.25	Tr.
Lead . . .	1.62	1.13	0.47
Iron . . .		1.71	

Incidentally the value of bronze about the end of the third millennium was 1 shekel of silver for 2 manas or $2\frac{1}{3}$ manas of *URUDU* (*TUrk.* 7).

7 (b) (1) URUDU.ZA.RÍ.IN = ŠU-nu (i.e. *zarinu*) and k(g)urnnu, probably orichalcum.

'S' 25, 26. *Ḳurnu* may be cognate with Syr. *k'rân*, a form of tin mixed with lead, or with *k'rîn*, *aes ustum*. A full discussion of *zarinu* = *orichalcum* will be found on p. 265, since my identification was made too late to print here; briefly, *zarinu*, specially connected with copper, is used to make a 'gold' crown which tarnishes, 'gold' dishes may be made of *ḥurašu ša zarîni*, and its equivalence with *ḳurnu* suggests an alloy. The Syr. *zarîna* 'a yellow earth from Armenia' suggests the Mossynoecian calamine for making brass.

7 (b) (2) Siparru(erû) arḥu, copper scale, copper oxide.

Both copper oxides are used in the Assyrian Glass texts of the seventh century B.C.:¹ the blue glaze is made with the black oxide, (no name is given for this oxide apparently): and the red glaze from the red copper suboxide, the latter being, as we should expect, included in *siparru arḥu* 'copper scale' ('copper of scale', or 'scaly copper').

(a) Directions for making the black oxide for blue glass.

Appendix i, sect. C. 'Thou shalt put 10 mana of copper (*erḫum*) into a clean melting pot: put it into a hot reverberatory furnace:² keep a fierce, smokeless fire burning until the copper is of a dull red (*iraššusu*). Thou shalt break up (and) crush 10 mana of *zuku-frit*:³ thou shalt

¹ Since my previous publication *OTC.* and Zimmern's in *ZA.* 1925, I have been able to add to the text.

² *Kûri ša dakkanni immeti*: see Introduction on the subject of the Furnace.

³ *Zuku-frit*, a simple glass, of which the components are uncertain (Appendix i, Sect. D).

open the furnace door, put down the frit (into the furnace) and let it lie on the copper (*erī*, singular) until the frit is used up (*im-ti-e-ma*)¹; thou shalt close the furnace door until the copper (*erī^{zun}*) and the frit have fused together and until they have become [one 'metal']: thou shalt agitate² (it) three times with the rake:³ thou shalt settle (?)⁴ (it) (with the rake), and shalt observe; if the 'metal' takes on the appearance of 'boiled wine',⁵ 'the metal' is boiled with the copper:⁶ thou shalt pour it on the brick: its name is *tersitu*.

(b) *Directions for making the red oxide of copper for red glaze.*

Sect. N+O.

'If scaled copper' is for [thee to make], 10 mana of *ahusa*, 10 mana of . . . -mineral (sand (?)) thou shalt put down into a cold furnace: thou shalt let a [fierce] fire burn: thou shalt let (it) reach a white heat [in?] an unclosed *haragi*-pan: thou shalt again let it reach white heat, [and into water] pour it. On a favourable day . . . thou shalt make a sacrifice in the presence (of the embryos):⁸ thou shalt set a censer of pine-incense in the presence (?): this shalt thou do, and on a favourable day put it down into a reverberatory [furnace] in thy (?) *haragati*-pan thou shalt (?) Thou shalt blow up the fire: with decorticated *styrax wood . . . until it is bright, beneath the furnace thou shalt burn. . . . Thy *haragati*-pan thou shalt again [let reach white

¹ *Imtī-ma*, lit. 'is decreased', 'becomes small'.

² *Tabihhiš*, Syr. *b'haš* agitavit. For this form cf. *idibub*, *limeššir* (MA. s.v.), *ilihīb* (AM. 90, i, r. 15). It occurs again OTC. pl. 2, rev. 58 (re-exd., Zimmern correct, and my *ta-bi-el-tū* wrong).

³ *Mutirru*, see Introduction on the subject of the Furnace.

⁴ *Tašīman* (i.e. *mam?*)-*ma*, . . . -*im-ma-am-ma*. *Tašīm* is not the usual present from *šāmu*, nor would *talimma* be the usual present from *lamā* ('surround'), another possible reading. I cannot help thinking that we have here a word for 'stir': I might add that *NIGIN* (*lamā*) may mean a twist in a horn, *karān enzi ša NIGIN* 'a goat's horn which is twisted' (with a possible suggestion that we might see in this the meaning 'stir' 'cause to revolve' KAR. 194, 38). Cf. HD. 104, on the making of glass 'for otherwise the Salt and Sand will, in the melting Pot, easily separate one from another, which they are apt enough to do were they not stirr'd with the Rake'. There is a difference apparently in two texts here, the second mention of 'rake' being omitted.

⁵ I doubt Zimmern's 'von reifen Wein(trauben)': certainly my translation in OTC. was wrong. In KAR. 191, ii, 8 (possibly dup. Speleers, *Recueil*, No. 318, 6) the brain of a *SUHUR* fish and seed of *Ū.GIR.GIL* plant are to be drunk in *karāni bašlī* by a man who evacuates blood. This must be the mod. *dibs* of the Arabs of Syria, grape-juice boiled down to syrup (not of dates, as in Mesopotamia) (Smith, DB. 1685).

⁶ This latter phrase is perhaps not on one text.

⁷ *Siparru arĥu*. For *arĥu* 'scale' 'husk' cf. *iarāhu*, no. 9 (d). *Siparri arĥi* occurs again, OTC. pl. 3, 102.

⁸ Used in the magic of preparing the furnace: see OTC. 70.

heat?]. Three mana of scaled copper¹ thou shalt put down into a ladle (?) (*su'li*) [and into] the *ḥaragi*-pan thou shalt put (it). Thou shalt increase the fire . . . thou shalt guard until ('destroyed?')². . . . The *zūkū*-frit thou shalt put into the copper³: thou shalt keep the fire burning. . . . With the rake thou shalt agitate (?)⁴ (it) three times . . . This is the *tersitu* for red glaze (*ukūnū sāmu*). Thou shalt take it out of the furnace: thou shalt blow, scale it off the copper⁵: on the brick put it; put water thereon. The composition (*epišti, egirti?*) for red glaze.'

I cannot help thinking that in this last description the scribe has confused two ancient texts. For one thing he seems to use *siparru* and *erū* indiscriminately for 'copper': for another, the word *ḥibi* is suspicious. If this be so, then the apparent confusion in the process may be explained, for it certainly is not clear at present.

Still, it is certain that the Assyrians made the two oxides, and Pliny's account is very enlightening: 'The flower, too, of copper is also used in medicine: a substance which is procured by fusing copper, and then removing it into another furnace, where the repeated action of the bellows makes the metal separate into small scales, like the husks of millet, and known as 'flowers of copper'. These scales are also separated, when the cakes of metal are plunged into water: they become red, too, like the scales of copper known as 'lepis', by means of which the genuine flower of copper is adulterated, it being also sold under that name. This last is made by hammering nails that are forged from the cakes of metal.' For the Syr.-Arab method, see Berthelot, *Coll.* ii, 31, where the result is to be exposed to the sun. Blancourt (*Art of Glass*, 77) directs that the copper be burnt in a closed crucible for four days (but not melted), beaten on a porphyry stone and sieved, when a black powder will be the result, which should be spread on the tiles: it is then to be put back in the furnace for four days more, taken out, the ashes blown off, reduced to powder and sieved. *TC.* ii, 421 describes cuprous and cupric oxide: 'Copper scale, which falls from hot metallic copper when it is worked with the hammer, is a mixture of these two oxides. The portion of the scale next to the metal consists of the red cuprous oxide, while the outside portion is composed of the black cupric oxide. Dioscorides and Pliny mention the existence of the red compound, indeed they distinguished two varieties, the one obtained in the form of a finely divided powder by pouring water on the surface of freshly melted copper, and termed *flos aeris*, and the other obtained as copper scale and termed *aeris squama*.'

¹ *Erū arḥu*.

² *Ḥibi*, perhaps the usual scribe's word to show a lacuna in the tablet from which he is copying. *Im-ma-ri-'u* follows.

⁴ *Ta-da'-ib*, in place of *tabihḥiṣ* in the parallel quoted above.

⁵ *Siparru*.

³ *Siparru*.

7 (c) Mesû, URUDU.ĤU.LAĤ.ĤA, 'washed' copper: URUDU. LAĤ.ĤA, uncertain.

'S' 27. There may be a distinction between these two kinds of copper: the former occurs in the syllabaries with the single adjective *mesû* as its equivalent, and it is paralleled by URUDU.SAĤAR.ĤU.LAĤ.ĤA (7 (a)), 'copper+dust+washed = what comes out of the mine'. URUDU.LAĤ.ĤA occurs about the middle of the third millennium, ITT. 6676, 6853; Scheil, RA. 1921, 51, 13, fifteen manas. URUDU sa-am-sa-tum LAĤ.ĤA, Scheil, RA. 1917, 181.

Mesû, properly 'to wash' is used for 'cleansing' ground for building (TP. vii, 76). Actually in a Chemical Text (OTC. 143, Sect. QQ, cf. Sect. PP), to one mana of *erî mi-si-i* . . . ten shekels of *anaku* (lead, tin) are to be added, with two shekels of . . . (the result being mutilated). Here the *erû* is added in full, *mesû* presumably not being considered obvious enough alone. That this use of *mesû* may not mean anything peculiarly recondite would appear to be shown by a parallel use with *mil'u* 'saltpetre': *mil'u mesat* 'washed saltpetre' and *mil'u la mesita* 'unwashed saltpetre' (Appendix i, S and AA) in glass making, and doubtless this must be explained from the Indian methods of purifying saltpetre (see 1 (e-i)) where it is first washed and boiled in order to cleanse it generally, and then, in order to fit it for the market, it is again refined by boiling and washing. How far this process is indicated by *mesat* and *la mesita* we cannot, of course, say: but it may be accepted that in glass- (or bronze?-)making the ordinary impurities would have to be eliminated before a component could be used, and hence we may take *la mesita* to indicate only a partial refining, and *mesat* as an elaborate treatment. Silver (*KÛ.LAĤ.ĤA*) and copper (URUDU.LAĤ.ĤA) are defined by this adjective, and there must be some more elaborate meaning behind *mesû*, used specially in syllabaries, than the mere washing of the lumps of ore, and, just as saltpetre is subjected to a technical 'washing' to purify it, there must be some technical purification in this description of silver and copper.

7 (d) Ĥil erî, ILLU(= A.DAN).URUDU, 'gum of copper', prob. Pliny's chrysocolla.

In MT., for eyes, brayed with others, AM. 9, 1, 34: with *styra, blown in, *ib.* 9, 1, 39: with ^aAS.MUR (stibium) and realgar, *ib.* 20, 2, 6. Probably Pliny's chrysocolla, a carbonate of copper (so Bostock, NH. xxxiii, 26, and cf. K. C. Bailey, *Nature*, May 16, 1925, that it was malachite or basic carbonate of copper) which 'attains the hardness even of pumice', so that braying (constantly in MT.) is necessary; it was used in eye-salves (NH. xxxiii, 38). The 'gum' of course, is a simile from the hard, solidified exudations of the gum-producing shrubs. In

the alchemist's text (*Iraq*, 1936: Appendix ii), r. 32, *ID* (= *Ā*). *DAN* ša₁₀ *URUDU* 'gum of copper' defines a clay 'body' made up of clay steeped in verdigris and fired, i.e. a body with a hard green composition.

7 (e) *Šuhtu*, *ZABAR*, *DUB*, *EMEDUB* (Chic. Syll., Luckenbill, *AJSL*. lxxxiii, 169 ff.), verdigris, acetate of copper.

= Syr. *šlḥ'thā*, verdigris (Jensen, *KB*. vi, 556). If taken as cognate to the Syr. *š'hath*, aeruginem contraxit, the root should be *šahātu*: yet the Assyrian form may suggest *šāhu*, possibly to be connected with the Syr. *š'wah*, germinavit, i.e. from the copper putting forth a green bloom from the effect of acid. In *MT.*: for eyes: with ten *kisal* of oil on temples, spread 'š*uhtu* of the leatherworker'¹ on a skin 'of the back', bind on, *AM*. 12, 8, 5+dup. 20, 2, 5. Verdigris is used in India for ears, ulcers, and warts (*BMM*. 23): Pliny (*NH*. xxxiv, 26), prescribes it for eyes. Used by leather-dressers (*HD*. 339 'dyers, skimmers, hatters, farriers, and painters'). It was made, according to *NH*. xxxiv, 26, in several ways, including that by vinegar (for the same method in Babylonian in 1600 B.C., v. Appendix ii), or with husks of grapes (*EC*. 16: *HD*. 338). In India copper acetate (verdigris) is manufactured by the vinegar-makers, who buy copper filings from the copper-smiths, put them in a jar and cover them with distilled vinegar (*arag*), the pot being closed at night, but open during the day. After twenty-four hours the *arag* is poured off, and mixed with water and left to evaporate until only the acetate remains (*CPI*. 403).

Šuhat huraši 'verdigris of gold' probably refers to the 'tarnish' of impure gold, since pure gold does not tarnish (*AEM*. 90): it is brayed and applied to the head in mountain honey (*CT*. xxiii, 24, 24+*AM*. 2, 1, r. 2); cf., however, the chrysocolla of *NH*. xxxiii, 26 (5), properly 'gold solder', but more generally a green verditer occurring in gold and copper mines. Pliny (*l.c.*) says that the goldsmiths have a chrysocolla of their own, of verdigris of Cyprian copper, urine of a boy, and nitre, called *santerna*.

7 (f) *Tuskū*, *tušku*, (SÜ.ĤĒ?), *spodos*, oxide of zinc.

7 (g) *Lulū*, *KÜ.ĤĒ*, *pompholyx*, oxide of zinc: *lulutu*, *KÜ.*

ĤĒ, probably the same, with the additional possibility 'brass': *luludanitu*, *pompholyx*.

7 (h) *Elmešu*, *elmušu*, SÜ.UD.ĀG.(GĀ), brass.

To *OTC*. 38 and *ŶRAS*. 1929, 813, where I tried to show that *tuskū* was *cadmia*, impure oxide of zinc, I can add further evidence.

¹ For the sign see Meissner, *OLZ*. 1911, 385, and *SAI*. No. 62. Not written here as *SA* (*D*. No. 104, 6), nor *ZADIM* 'goldsmith'. Cf., in addition to *SAI*, the medical letter, King., *Cat.*, 4, No. 13, r. 1, and my chapter, Woolley, *Car-chemish*, 136, l. 36, where the context obviously relates to leatherworkers.

The forms in *OTC.* are *tu-us-ku-ū* (*Pl.* 4, iv, 2, 11, 21: 5, v, 11: cf. 17): [*tu-u*]*s-ku-u* (5, v, 25): *tu-uš-ka-a* (5, iv, 20: cf. 18). In *MT.*: for eyes, *tus-ka-a*, *AM.* 9, i, ii, 34: *^atu-uš-ka-[a]*, *AM.* 15, 4, 6: *ghostly attack*, [*tus*]-*ki-e* (v. *tu-uš-ki-e*) (*ša*) *amnappahi ni-ip-ša* (*KAR.* 182, i, 30: *AM.* 70, 2, 17+94, 7, 4: and 96, 4, 2: *JRAS.* 1929, 813): for a cough bray *tus-ka-a*, boil in *kurunnu*-beer, add (water) of honey and refined oil, give to drink without a meal, to make the patient vomit, *AM.* 80, 7, 7. Add [*tus*]-*ka-a* = *guhlu*, 'Q' 6, and prob. 'R' 21.

For *cadmia* in ancient times there were two meanings (*Coll.* 239): (1) the natural product from which brass was extracted: (2) a kind of soot from metals adhering to the walls, top, and openings of copper furnaces. It came also from the roasting of pyrites, and another, whiter and less heavy, from the silver furnaces. There are the following kinds: (a) *capnitis*, resembling white ashes: (b) *botryitis*, the best, hanging like grapes from the arches, used for eyes: (c) *placitis*, in crusts, for itch: (d) *onychitis*, bluish: (e) *ostracitis*, blackish, for wounds (both forms of (c)). Then there are two allied substances *pompholyx*, disengaged by washing, white and very light, compared by Diosc. to carded wool, the *lana philosophica*, and *spodos*, darker and heavier, and not washed, scraped from the walls. Both were oxides of zinc (v. *NH.* xxxiv, 33, 34: *Diosc.* v, 85: *Anc. Min.*, 67: *Coll.*, l.c.). *IB.* (437) says that the two are prepared by throwing pulverized *cadmia* on the fire in the furnace little by little, when it will vaporize, and the lighter particles will rise and attach themselves to the roof and walls (*pompholyx*), while the heavier (*spodos*) falls, mixed with earth. It is as well to note from the beginning that 'brass, as at first produced, must have been made from copper or copper ore and zinc ore, but not from metallic zinc' (*AEMI.* 181).

The use of *tuskū* in *MT.* certainly indicates a form of zinc: *SM.* ii, for eyes (*passim*), prescribes *cadmia*: so also Galen (*Sp. Omnia*, xiv, 7, quoted *MAM*, 156). Note its use in making a man with a cough vomit: cf. *DM.* i, 311 'an emetic of ipecacuanha, sulphate of zinc, or mustard, may be useful in relieving cough, by expelling secretion when this has accumulated in large quantity' (the salts of oxide of zinc are also an emetic, *EC.* 965). Note also the word 'smith' attached to *tuskū* (an addition also found with *lulū*, further).

In glass-receipts, where *tuskū* is used (see Appendix i), its effect may have depended less on its zinc contents than on its impurities. Berthelot (*Coll.*, *ib.*) says that *cadmia* really consisted not only of oxide of zinc, but included also oxide of copper, lead, sometimes antimony, and arsenious acid. One part of *tuskū* added to 360 parts of clear crystal glass (*dušū*) makes the glass *maškanti aparute aššaki*, which I take to be an opaque white ('alabaster') while $1\frac{1}{2}$ parts makes clear crystal glass into *maškanti asāndi aššaki*, a red result. Oxide of zinc will give a white,

but less opaque than oxide of tin, which, like arsenic, will turn glass opaque (Binns, *Ceramic Technology*, 70): tin is mentioned for Assyrian glaze by Layard (*Disc.*, 166, Assyrian: cf. Koldewey, *Das Ischtar-Tor*, 30): while modern soft white opaque enamel is made with 6 cwt. 'batch' (flint glass), 24 lb. of arsenic, and 6 lb. of antimony (Pellatt, *Curiosities of Glass-Making*, 34). Binns (*ib.*, 91), says that the tin may sometimes assume a pink cast, which might explain the Assyrian use of *tuskū* to make a red, but if cadmia contains a certain amount of copper, it should be remembered that an oxide of copper can turn glass red, nearly opaque (*EC*. 684).

Again, the making of [ba]h-ri-e, which I take to be red coral, is with one part of go[ld], 20 of *abaru* (lead, or antimony), 32 of [tus]kū (cadmia), 7200 of *zūkū*-glass, and some saltpetre, which represents the Assyrian equivalent for the Purple of Cassius, as near as a mutilated text allows (*v*. 5 (a), and Appendix I, DD.). Modern components to the glass and gold may include borax, oxide of tin, oxide of antimony, saltpetre, arsenious acid, or cream of tartar, which again suggest some of the impurities of cadmia.

Lastly we have *šigtu tuskū* (Syr. š'yāg'thā, lotio) 'washing of *tuskū*', in a receipt for making green crystal (Appendix I, Sect. S.) (Neri (Merrett), 1662, p. 35, says that brass (copper with lapis calaminaris) gives a green to glass, but it is doubtful if this is applicable here, since we are dealing with the oxide of zinc, and hardly brass.) *IB.* (*ib.*) gives the method of washing pompholyx, by enclosing the substance in a linen bag and putting this in a vessel of rain water, and shaking it, whereby the lighter particles escape into the water, and the heavier and more impure remain. This water is then shaken so that the pompholyx is thoroughly cleared, and the latter is then dried. (Cf. Zosimus, *Coll.* 201, and the Arabic *tutia maghsūl*, 'washed tutia', H. Kroner, *Z. Term. d. Arab. Med.*, 50).

Next, cf. the equations for *tuskū*, *nīṣa erī* and *īpri erī*. *Nīṣu*, from *napāṣu* 'break in pieces' (cf. *nīpīṣ šir'ani*, Br. 12103), will be the 'crusts' of the placitis: *īpri erī* 'dust of copper' will be the more finely divided. Curiously enough in *SEC.* 10 these words are paralleled: 'its [i.e. zinc] ores were used in the manufacture of brass, and the term "cadmia" seems to have been applied to such ores as well as to the oxide of zinc obtained as crusts or dust from the brass furnaces.' I would draw attention to this quotation, not only because of its 'crusts or dust', but because we shall have to consider the other meaning of cadmia as brass.

In *MT.* *nī-īp-ša erī* is used for *eyes* (*AM.* 14, 5, 7: = Arab. *lašīf*, *stimmi*? See Sprengel, *Diosc.* ii, 645). *īpri erī* is more common: for *eyes*, bray and apply with a 'needle' of antimony with oil, *AM.* 11, 2, 21: bray, apply, *AM.* 11, 2, 29, 30, 31, 32: mix with *šihiltu*¹ and apply in

¹ I have translated this 'effluence' (Aram. *šihlā*, *PRSM.* 1926, 34), referring to the previously prescribed pounded green plant-drug.

mountain-honey, *AM.* 13, 6, 12: bray with *ḥimetu*-ghee, and apply, *ib.* 15: bray fat in it and apply, *ib.* 16: in honey, *ḥimetu*-ghee, and cedar-oil, *AM.* 14, 1, 2: ('in oil and copper-dust') *AM.* 15, 6, 3: ('in oil, copper-dust'), *ib.* 4 (cf. 6, and 13): in mountain-honey, *AM.* 17, 4, 10: *epir erī ša SUN.DU*₁₃ 'copper dust of a small pan', bray in *ḥimetu*-ghee for eyes, *AM.* 20, 2, 7, comparable to *erū ša SUN.DU*₁₃ 'copper from a small pan', brayed in *ḥimetu*-ghee for eyes, *AM.* 12, 8, 9: [*epir erī*] *ša SUN.DU*₁₃ *tašammāt* '[copper dust] from a small pan make an extract (or, take off) (and apply seven days)', *AM.* 11, 2, 23. For *head*, apply *epir erī* in oil, *CT.* xxiii, 26, 3. Uncertain, perhaps for bodily irritation of some kind, *AM.* 44, 1, iv, 4. With *tuskū* settled as some form of cadmia (with its allied form 'washed cadmia'), *nipša erī* as placitis, and *ipri erī* as the special dust of cadmia, we can go on to the other form, *lulū*.

Lulū (*lulutu*, *KŪ.ḤĒ*) 'Q' 9, 10: 'R' 10, has nothing to do with 'pearl' (as Viroleaud and I thought, comparing the Arab. *lūlūdh*, see *OTC.* 16). Its inclusion among the cadmia groups, the addition of 'of the smith' (*AM.* 26, 2, 8), its propinquity to *tuskū* in the Glass-texts (one occurrence, Sect. T = BB, Appendix i), its use for eyes, all suggest a connexion with cadmia. *KŪ.ḤĒ* would appear to mean 'the bright thing of the dome'¹ (as distinct from the similar *SŪ.ḤĒ* 'that which sinks to the bottom of the dome', see p. 77). It is male and female (*AM.* 36, 1, 10), like the *tutia femina* and *marina* (*EAA.* 369).

In *MT.* *KŪ.ḤĒ* (*lulū*) is used: for eyes (brayed in sheep's marrow alone), *AM.* 15, 6, 12: with others, *AM.* 16, 3, 5: *nostrils*,² blown in (snuffed up?), *AM.* 26, 2, 8: *ears*² ('male and female', with salicornia alkali on wool), *AM.* 36, 1, 10: to stay menses, brayed with magnetic iron, iron, &c., on wool, in uterus (as styptic, *KAR.* 194, 45).

In the Glass-texts *lu-lu-u* occurs once (Sect. T = BB, Appendix I), where a very small quantity is used with *tuskū* (spodos, the other form of oxide of zinc) in making crystal-glass. As with *tuskū*, the probability is that *lulū*, as an impure oxide of zinc, will on occasion contain something of value in the glass.

It is a question whether the equivalence [*lu*]-*lu-tū* for *KŪ.ḤĒ* ('Q' 10) is exactly the same as *lulū*, or whether it is at times some derived product (even brass?). This passage is the only place where the equivalence is given: and the use of *lulutu* = *HU.LAH.ḤA* suggests something different. *Lulutum* frees a tabu, *KAR.* 185, iii, 3; occurs in a receipt of

¹ *ḤĒ* = *ibkennu*, *šupuk* (*šamē*): *šapāku* is 'to heap up', i.e., to make a dome-like heap (of corn): *šupuk šamē* is the dome or vault of heaven. If so, *ibkennu* should mean 'vault', and I would suggest as cognate the Syr. *bīnka*, fornix (explained as *banca*(?)).

² Pliny (*NH.* xxxiv, 25) says that *lepis* (scale) and flower of copper are used for excrescences in the nostrils and anus, as also for dullness of hearing, being forcibly blown into the ears through a tube.

minerals, K. 9762: in a ritual, ii R. 17-18, ii, 49 = Haupt, *Akk. Sum. Keils.*, 89, 47: *unḳi luluti abnu ella ša ištu māti-šu ibbabla ana ḳuḳani ša ini-šu ina ubani-šu šiḫirti ina šumeli-šu šukun-ma* 'a ring of lulutu, the shining mineral, which is brought from its country (mountain?) for the ḳuḳani of his eye, place on the little finger of his left hand'.¹ This last does not coincide with what gathers in the dome of the furnace. Yet, if the form *lulutu* bears the same relation to *lulū* that *namrutu* does to *namru* (lime) (No. 18 (c)), it may be that *lulutu* is not necessarily always distinct from *lulū*.

^a*Luludanitu*, from its similarity to *lulū*, must surely be connected with it.² It occurs (^a*lu-lu-da-[ni-tu?]*), *AM.* 102, 31, with many others, to bind on temples, and used as an ointment after being broken up and powdered. (*HD.* 338 says of pompholyx 'it is not much us'd, but externally for Ointments'.) Most important is *KAR.* 307 (*TL.* 33):

(30) *šamū elīti ^aluludanitu ša ^{iu}Anim 5 × 60 ^{iu}Igigi ina libbi uš[ibu]*
 (31) *šamū ḳablūti ^asaggilmūt ša ^{iu}Igigi belum ina libbi paramahḫi ina libbi (!)* (32) *ina parakki ^auḳnī ušib 'buši ^aelmeši ina libbi unammir* (33) *šamū šaplūti^{bl} ^aašpū ša ^{mul}lumaši ša ilāni^{bl} ina muḫḫi ešir* (34) [*ina dann*]at *iršitīm elīti zīḳiku amelūtu ina libbi ušarbiš.*

'The upper heaven is of *luludanitu*, of Anu: 5 × 60 Igigi dwell therein. The middle heaven is of *saggilmūt* (thunderbolts), of the Igigi: the 'Lord' in a shrine therein on a throne of lapis-blue sits; the *buši*-wood makes the brass brilliant. The lower heaven is of jasper, whereon the *lumaši* stars of the gods he has marked. [On the ba]se of the upper earth the wind makes mankind to lie flat.'

Now here the symbolism is of a brass-founder's furnace. The heavens represent the dome, and are divided into three; the upper containing *^aluludanitu* (on our assumption, a form of *lulū*, the white, flocky cadmia): the middle the thunderbolts (the metal, as my friend Mr. Gadd suggests to me), with the sky-blue of the throne. Then the *elmušu* (brass) is cast, the *buši*-wood 'making it brilliant' (this latter must represent the charcoal, used to deoxidize the calamine³). Then the lower heaven with red jasper of the morning and evening sky representing the fire; while below on the earth the 'wind' is mentioned, being symbolic of the bellows fanning the flames.

^a*Luludanitu* will represent the clouds of the sky-dome, the *capnitis*

¹ Where should six mana of *AN.NA.LU.LA* be included (*ITT.* v, pl. 26, 6853, i, 2)?

² Cf. the plant *^ašimrānu* described as 'like *^ašimrum*' (*CT.* xiv. 19, i-ii, 18: *AH.* 51).

³ *Buši* can hardly be the name of a wood, since (as far as I know) the syllabaries do not record such a name. It might be read *sirši* (in the same way in which I have read *bušu* = *siršu* 'glass'). I can suggest only that it is either something representing a heavenly charcoal or wood, which, by the parabolism here, is the oxidizing charcoal (see further).

('smoky' cadmia) or the white vaporized particles of pompholyx. *Danitu* must either be an adjective, not connected with *dannu* 'strong', but with the Syr. *etd'nē* 'adhered', referring to the adhesive quality of the *lulū*; or the word is (as *ša ilu Anu* suggests) simply for *lulutu Anitu* 'heavenly pompholyx'.

But what, then, is *aluluda[nitu]*, bound on the temples in *MT.*, and especially *HF.* No. 80, (18) 7 *IGI aPAR.AŠ adi 1 lulidanitum iħzu* . . . (19) 6 *IGI aPAR.AŠ šihrūti^{pl} la iħzu* (20) 4 *IGI aširgarri iħzu ħuraši* 'seven beads of calcite beside one *lulidanitum* set . . . : six beads of calcite, small, not set: four beads of serpentine (or sim.), set in gold'? What form does this take as an amulet here?

7 (h) Elmešu, elmušu, SŪ.UD.ĀG.(GĀ), brass.

The next is the important word *elmušu*, *elmešu*, *SŪ.UD.ĀG.(GĀ)* ('Q' 14, 'R' 22), at the foot of the list of furnace products, zinc, &c. Hitherto, following Haupt, I took it to be electrum (*GE.*, text, 80), it being known for its brilliance ('I will make shine the light of *ilmešu* in the face of Esarhaddon', iv *R.* 61, [68] iii, 33), and used for the horns of a chariot in *GE.* vi, 11 (*elmišu ħarnā-ša*). But, inasmuch as it is included definitely in our lists of zinc oxide, I think we must see our 'brass', and not electrum, in it. *SŪ.UD.ĀG.GĀ* ('sink down' + 'bright' + 'amalgamation'¹ suggests the bright metal sunk to the bottom (of the furnace), like *spodos*), in other words, the deposit of the furnace. That *elmešu* is brass is thus suggested in the above poetical comparison of the sky to a furnace dome, where in conjunction with *ibuši* (something of wood, probably representing the oxidizing charcoal) the nodules of thunderbolts form the base of *elmešu*-brass, the pompholyx (*luludanitu*) flying to the upper part of the sky as clouds, and the fire represented by the jaspers of sunset, and the blast by the winds.

Pliny (*NH.* xxxiv, 22), speaks of cadmia (furnace-calamine), a product of the fusion of the ore of copper or zinc (see Bostock's note): cadmia was the ore by which copper could be coloured yellow (*Diosc.* v, lxxxiv). Aristotle says that the Mossynoecians (S. of the Black Sea) made a *Χαλκός* of a pale colour, by mixing it with a certain earth found among them, which is taken to be calamine, the cadmia of Pliny, an ore of zinc (*Op.* v, i, quoted, *Anc. Min.* 46: see *EB.* 11th ed., s.v. 'Zinc'). Strabo (xiii. 1, 56, quoted *Anc. Min.* 66) says that near Andeira, a town of Troas, is found a stone which, being burned, becomes iron, and distils false silver when heated in a furnace together with a certain earth, which earth, receiving the addition of copper, forms the alloy that some call brass (orichalcum). Zosimus (5th cent. A.D.) (*HI.* ii, 36) says that to make brass, Cyprian copper must be melted and pounded

¹ The sign *ĀG (RAM)*, *rāmu* 'to love' shows in its original hieroglyph (see Thureau-Dangin, *Recherches*, No. 62) a penis entering a vulva.

tutia strewn over it. Macalister (*Gezer*, ii, 265) mentions brass of the Third Semitic period in Palestine with 23.4 per cent. zinc: brass has been found in Rhodes (apparently 6th cent. B.C., *MAM.* i, 165). Are we to include here the *eršum pišū* 'white bronze', mentioned with gold, silver, lead, &c., from Mušasir (near L. Van, taken by Sargon, 8th cent. B.C.: *HC.* 352: cf. 129), perhaps orichalcum (but cf. Bilati = Aphrodite, white copper, *Hist.* ii, trans. 123)?¹

An important text (*Türk.* No. 124, viii, 3 ff., time of Ur-Lama: Thureau-Dangin, *RA.* 1907, 142) mentions 1 mana 4 shekels of *URUDU.LAḤ.ḤA* (refined copper), 10 $\frac{2}{3}$ shekels *AN.NA* (tin), 4 $\frac{2}{3}$ *NE.KU*, $\frac{1}{2}$ shekel, 21 grains of *SU.ḤÉ*. We have no Semitic value for *SU.ḤÉ*, but two inferences may be drawn: (a) from *lulú, KU.ḤÉ*, 'the bright thing of the dome (furnace)', pompholyx, flowers of zinc, the light white oxide: (b) *SU.UD.AG.GÁ, elmešu*, which I am taking as brass, 'the bright thing (*UD*) which is cast (*SU, raḥú* 'pour', or *ṭibú* 'sink') after amalgamation'.² Here *SU*, having the value of 'fall', suggests the property of spodos, *tuskú*, the heavier oxide of zinc which falls to the bottom of the furnace in brass-smelting, from which we may infer that *SU.ḤÉ* 'that which falls to the bottom of the dome (furnace)' (= spodos) is used in contrast to *KU.ḤÉ*, 'the bright thing of the dome (furnace)', the pompholyx which rises to the top. From this it might be suggested that the Sumerian for *tuskú*, spodos, is *SU.ḤÉ*. Applying this to our text, we get 80.05 per cent. copper, 13.34 per cent. tin, 0.77 per cent. zinc oxide, and 5.84 per cent. *NE.KU*. This amalgamation, omitting *NE.KU*, which I will discuss, results in something like gun-metal, one form of which contains 89.3 per cent. copper, 6.8 per cent. tin, 2.2 per cent. zinc, 1.2 per cent. iron (*EC.* 121). For other similar compounds, cf. *ib.* Col. ix, 1, ff.³ What, then, is *NE.KU*? It is well known that in melting bronze or brass, the addition of charcoal as a deoxidizing agent is of great value: 'many foundries cover their melted metal (i.e. bronze) with fine charcoal or coke' (*EC.* 383): and brass 'was formerly made by igniting metallic copper with calcined calamine (oxide of zinc) and charcoal, the latter deoxidizing the calamine' (*ib.* 373). Literally the word *NE.KU* means 'ash (cinder) eaten (by fire)', so that there is no difficulty in seeing 'charcoal' in the

¹ On 'bright copper' (Democritus) see *HCh.* 31. Note also that in India, 'what has been called *white copper*, and which is much used in China, Dr. Black supposed owed its distinguishing colour to nickel. Nicholson, on the other hand, thought it was an alloy of copper and arsenic' (*MM.* i, 508: see also p. 509).

² Note in Scheil, *RA.* 1921, 51, i, 11, . . . *mana ḤÉ.AG* distinct from 1 shekel of *SU.AG* (i, 19).

³ In *ITT.* v. pl. 13, No. 6763 (cf. p. 22, *ib.*) half a mana of *SU.ḤÉ*, oxide of zinc, is delivered to the smith for axes. Zinc, uniting readily with tin, hardens it, doubtless used here similarly (*EC.* 965). 'The hardness of zinc-copper alloys is usually greater than the mean of the constituents' (*DAC.* 1913, v, 815).

word.¹ Not only does it occur in these texts for brass-making, but we find it also in texts concerning wool, where it is connected with fat or oil, obviously as the other component of a wool-washing soap, ashes (i.e. charcoal). Beech-ash would appear to have been used in certain early soaps (*EB*. 11th ed., s.v.): doubtless it would be willow or oak in Mesopotamia. It is distinct from soap made with alkali (De Genouillac, *RA*. 1909, 113, *I ka* of *NI* (oil) with $5\frac{1}{2}$ *ka* of alkali (*nidaba*)): e.g., after several totals of wool, oil, *NI.NUN* (*himetu*-ghee), dates, and copper, come 'total 4 talents 2 mana of goats' hair, total $\frac{1}{3}$ *ka* *NI.NUN.DUG.GA* (good *himetu*-ghee) *NE.KÚ.BI* (its charcoal) $1\frac{1}{3}$ shekel' (*AT*. No. 50, iv, 7 ff.). We may, therefore, accept it as certain that the Babylonians of the middle of the third millennium were capable of making a compound of copper, tin, and zinc, which they deoxidized with charcoal.

Here may be added the woman's name Elmešu (Bu.88- 5-12, 212, *CT*. ii, 12, 3, (1st dyn. of Babylon)), and the goddess *DINGIR.SÛ.UD.ÁG*, ii R. 57, 31, *a*, a form of *Ai*, the wife of the Sun god. Cf. also the plant *ŠÁ.ŠAR* = *elmeštu*, *šaddaru* (see Langdon, *RA*. 1916, 33: *D.* repeats the superseded *kur-m[a . . .]* of *SAI*. 6014): this must be cognate with the Arab. *sadara* 'be confused' (the *ŠÁ.ŠAR* meaning 'heart-plant', a narcotic: cf. *AH*. 44, where I see I have made a mistake). The synonym 'brass plant' suggests the dull yellow flowers (traversed with purple veins) of the *hyoscyamus niger* (as an additional kind of *hyoscyamus* to the *šakiru*). Lastly, in a description of minerals, ('... this mineral, its name is *elmešum*') the composition is lost (*K*. 4751, 2).

Philologically, *lulû*, the 'bright' thing adhering to the furnace roof, is perhaps connected with the Arab. *lâlâ* 'shone'. Tutty, tutia, tucia, has been compared to the Skr. *tuttha* 'blue vitriol' (Murray, *New English Dictionary*, s.v., quoting Vullers), and to Pers. *dud* 'smoke' (*EAA*. 665). It does seem possible, however, that our Assyrian *tuskû* may be connected with it, since *s*, *k*, *š*, *h* play strange tricks (Alexander, Iskander: *hašhuru*, *hazzûrâ*: Khshayarsha, Xerxes: Patusarra, Πατεισχορεus (Lenormant): and more simply, Arab. *tha* = Ass. *š*). *Elmešu*, rather the Heb. *hallâmîš* (Jensen, *KB*. vi, 448, 574, 'Metallglanz') than the Heb. *hašmâl* (Haupt), suggests the meaning 'brass' for the Heb. instead of 'flint', which the mining passage in Job xxviii

¹ I must entirely disagree with Deimel, *Orientalia*, 2, 59, that this word means the loss in weight from the metal in the smelting: 'Es handelt sich hier um "Rohwolle"; denn bei der Herstellung des ersten Wollpostens ist genau $\frac{1}{3}$ des Gewichtes *izi-kû* = "Feuerfrass". Dieser Ausdruck ist vom Schmelzen des Metalles hergenommen und bezeichnet den Gewichtsverlust bei der Reinigung des Metalles durch Feuer. Bei der Rohwolle handelt es sich um Reinigung derselben, hauptsächlich um Entfernung des anhängenden Öles.' It must definitely be a chemical.

bears out. The Arab. *ḥal nabûs* 'flint' may have nothing to do with it. It is conceivable that calamine, in Syr. *kalmîâ* (perhaps a corruption of *cadmia*), is a descendant of this word: Agricola's derivation from *calamus* c. 1546 is hardly satisfactory.¹

7 (i) Erû BE ša *kaḫḫaru* *ikkalšu*, ZID.URUDU.NI.KÛ.E, Tutty, or *Aes Ustum*? 'Roast' (or, improbably, 'old') 'copper which the earth has eaten': 'dust of copper eaten'.

'Q' 13. There are two possibilities: (1) that it is a form of tutty, inasmuch as it follows *tuskû*, and if so we may compare HD. 341: 'Tutty is found sticking to Rolls of Earth, which are hung up and placed on purpose on the Top of the Furnaces where the Founders cast their mixed and Bell-metal to retain the Fume or Vapour, like the Smoke in Chimneys; and by the Means of these Rolls the Vapour is retained and reduced into a shell of the same Figure as these Rollers': or, (2) it may be the true *aes ustum* which is made by putting red copper into a crucible with sulphur and a little common salt, putting this into a charcoal fire (HD. 338: cf. HS. ii, 31). The former is used for eyes, which coincides with *erû* BE (AM. 11, 2, 27) used in *ḥimetu*-ghee for eyes: the latter is a detersive and is used for eating off dead flesh. (HD. 338.) URUDU.BE is one of seven drugs for 'when a man *ašâ parittu u LU . . .*' (Kû. iii, ii, 13). That BE is more probable as 'roasted' than 'old' is, I think, certain: cf. *ZA.ṬU.BE* 'red lead' (roasted white lead, 16 (a)): the Syr. *n'ḥâšâ ḫalyâ* 'burnt copper' is common in eye-prescriptions, SM. ii, 88 ff.

7 (j) URUDU.A.EN.DA, uncertain.

A.EN.DA used before, and after URUDU, and even alone: before, RTC. 25, 1: after, ITT. 1349 (one talent): 9257: RTC. 23, a, r. 9; 24, 1: ITT. 9257: alone (120 mana, with 5 of AN.NA, tin) RTC. 19, iv, 4, and cf. Barton UP. 9, 1, 33.

To sum up Copper: the words *erû* and *siparru* vary curiously for copper and bronze; about 2700 B.C. bronze was replaced by copper for a time. The copper ore, cleansed of earth when it first comes out of the mine, is called URUDU.SAḪAR.ḪU.LAḪ.ḪA: a copper refined by smelting is apparently URUDU.ḪU.LAḪ.ḪA. By the seventh century the two copper oxides (the scales called *siparru arḫu*) were used in glass-making, and, of course, must have had a much earlier date: carbonate of copper was called probably 'gum of copper', a name which goes back to 1600 B.C. at least: *šuḫtu* was acetate of copper. A compound of copper, tin, and oxide of zinc was known in the middle of the Third Millennium (*elmešu* is the word for 'brass': perhaps the origin of 'cala-

¹ For a change of final *s* to *n*, cf. Nisibis, Nisibin: in AH. 273, 42-43, apparently a Hittite word occurs as *ḫarazias* and *ḫarazium*.

mine'), the words for the oxides of zinc being *tuskû* (tutty?), *spodos*, and *lulû*, pompholyx, with an equivalent, *lulutu* (which perhaps has also the derived meaning of 'brass').

8. IRON

8 (a) Parzi(l)lu, AN.BAR, iron.

Although iron melts at 327° C., it does not become liquid enough for casting until about 1500° C., which, Lucas says, is much too high a temperature to have been obtained anciently (*AEMI*. 198). *AN.BAR* 'iron', containing the sign for 'heaven',¹ long ago suggested meteoric iron. Dr. C. H. Desch (*The Times*, July 28, 1933) refers to an axe from the Royal Tombs at Ur of meteoric iron, and to a fragment from Al-'Ubaid made 'from a meteorite forged at a comparatively low temperature' (*UE*. ii, 293). But he goes further, showing that a bronze dagger handle from Tell Asmar, which Frankfort (*Or. Inst. Communications*, 17, 59) assigns to 2700 B.C., contained a lump of iron *free from nickel*, and so was *not* meteoric. This is parallel to the theory that iron was early known in Egypt: it is true that beads of iron of pre-dynastic date have been identified (*AEM*. 97: *MAE*. 114), but these have not been accounted conclusive (but see *AEMI*. 197), the best evidence for early iron being the piece discovered actually in an inner joint in the Great Pyramid in 1837, and duly attested (see *AEM*. 228). An axe said to be of the Fifth Dynasty was by no means so certain (for other later occurrences, see *AEM*. 97). The evidence now would, however, appear to be overwhelming that iron was known at this early period, at all events in small quantities. Indeed the very name *pa-ar-zi-li* was discovered by Scheil (*RA*. 1928, 42) as existing in the 1st Dynasty from Susa. *AN.BAR* (?) is mentioned on a text also of the 1st Dynasty of Babylon (*IGI 6 GĀL kaspi ša 1¹ šiklu AN.BAR* (?), *CT*. vi, 25, Bu. 91-5-9, 405, 8, quoted *Bab.-Ass.* i, 265). But it is not until the thirteenth century that iron is beginning really to come into prominence (see Sidney Smith, *Early Hist.*, 293). The oldest mention of *AN.BAR* in an Assyrian inscription, according to *IAK*. 123, is of Shalmaneser I, thirteenth century (*KAH*. i, 13, iv, 20).

For its magical connexion with magnetic iron, see *ašadānu šabitu* (No. 8 (g)). It may occur next this (*KAR*. 213, 1, 28: *ib.* 4, 27: *KAR*. 194, 45) or with *uknû* between (*KAR*. 213, 1, 7): with many between (*ib.* 2, 29). In *MT*. *AN.BAR* is used: perhaps for *Hand of Ghost*, *AM*. 94, 7, 8: to stay *menses*, with *aAD.BAR* on a thread, to be placed on pubes, *KAR*. 194, 31: with magnetic ore, pompholyx, &c.,

¹ *AN.BAR* means 'heaven+flash', (the flash of the meteor?). A 'black *AN.BAR*' comes apparently from the mountain Daggata (along with copper) in Cyprus, *KS*. iv, 81, 39-40. For meteoric iron in Egypt see *AEMI*. 197.

on wool, on *uterus*, *KAR.* 194, 45: for *temples*, *AM.* 14, 4, 7: *ZID.* *AN.BAR* 'powder of iron' for *eyes* (?), *AM.* 85, 2, 9: with magnetic iron powder, &c., in love-charm, *KAR.* 70, r. 22. *AN.BAR* would certainly appear to be similar to simple *AN.BAR* as a metal: note particularly *AN.BAR* ('iron stone') *šadānu šabitu* (magnetic ore), *AM.* 102, 17, with *šadānu šabitu AN.BAR*, *KAR.* 194, 45: (*AN.BAR* occurs again along with [*šadānu*] *šabitu*, *CT.* xxiii, 44, 4: cf. *KAR.* 182, 11, and *AM.* 97, 4, 27). Male *AN.BAR* is used against the approach of sorcery, *AM.* 86, 1, r. iv, 5. *AN.BAR* is used for anointing neck, *CT.* xxiii, 44, 4 (cf. as above): thread fourteen *AN.BAR*, *BE.* xxxi, 60, 24: uncertain, on blue wool, *AM.* 17, 3, 9.

Iron is found at Tura Duri (Tiyari) (oxide of iron, yellow limestones with ferroxides, *Tr.* 215): SE. of Euxine, Taurus and Anti-Taurus, Gowland, *JAL.* 1912, 281: throughout the Hormuz series (Persian Gulf, with red iron oxide from various islands, Pilgrim, *MGS.* xxxiv, 156, 157): in Persia at Juwan (Mactear, *TIM.* 1894, 4). For the process of smelting at Siliski, near Diurik (Dumbugh Dagħ), see *Narr.* 527.

Ḥabalki(n)nu, a word used in Tushratta's gifts to Amenophis, has been tentatively supposed to be steel, for no more reason than that it is a dagger blade, ((1) *paṣru ša lišan-šu ḥ[a]-b[a]l-ki-i-in-nu*, *TA.* 22, i, 32: 1 *paṣru ša lišan-zu ḥa-bal-ki-nu*, *ib.* iii, 7: 10 *giakātum ša ḥa-b[al-ki-ni]*, 10 *giakātum ša [si]parr[i]*, *ib.* iii, 49, 50). At the same time it came from a state not far from the Chalybes, and there is certainly a possible 'merchant's garbling' in *ḥabalkinu* and χαλκοβικός (χαλκοβίανον, the late Greek word, is much less satisfactory). Cf. 'W' 15.

8 (b-h) The Iron Oxides

8 (b) *KA*, iron ore, ochre, esp. red.

8 (c) *KA.GÍG*, black ochre.

8 (d) *KA.PAR*, 'white' ochre.

8 (e) *KA.SIG₇*, yellow ochre.

8 (f) *šadānu*, *KA.GI.NA*, hard (heavy) iron ore, haematite.

8 (g) *šadānu šabitu*, *KA.GI.NA.DIB.BA*, magnetic iron ore.

8 (h) *šadānu balṭu*, *KA.GI.NA.TIL.LA*, ferrum vivum.

8 (b)-(f). Note the following late Bab. syllabary (Scheil, *RA.* 1918, 115, 2 ff. repub. *TU.* No. 36):

2. <i>KA.GI.NA</i>	<i>ša-da-nu</i>
3. <i>KA.GI.NA.TIL.LA</i>	„ <i>bal-tu</i>
4. <i>KA.GI.NA.LAḤ¹</i>	„ <i>nam-ri</i>
5. <i>KA.GI.NA.ŠIG₅</i>	„ <i>dam-ka</i>
6. <i>KA.GI.NA.KALAG.GA</i>	„ <i>dan-nu</i>
7. <i>KA.GI.NA.DIB.BA</i>	„ <i>ša-bi-tum</i>

¹ The order is thus in *CT.* vi, 12, 1 b for the first three, although this *LAḤ* might actually be *KALAG* (see l. 6) on the *CT.* text.

- | | |
|---------------------------------|-----------------|
| 8. ^a KA.SĪR.KA.GI.NA | \| ki-šir ša-da-nu |
| 9. ^a KIŠIB.KA.GI.NA | \| ku-nu-uk-ku |
| 10. ^a LAGAB.KA.GI.NA | \| ši-bir-t[um] |
| 11. ^a BIR.KA.GI.NA | \| tuk-pi-t[um] |

I suggested in *OTC.* 120 that the various forms of haematite and iron ores were represented by ^ašadānu, ^aKA.PAR, ^aKA.GĪG, and ^aKA.SIG.¹ ^ašadānu (lit. 'mountain stone', Geller, *AOTU.* 1917, i, 4, 281, but not 'Bergkrystall', *ib.* 339, and *Bab.-Ass.* i, 351) must be the Arab. *šādnah*, Syr. *šdnā* 'haematite'. *KAR.* 185, r., 10 ff. gives the six (principal) seal-stones, with their protective values to the man carrying them, the substances being ^ašadānu, ^auknū, ^adušū, ^aZA.ṬU PAR.AŠ, ^aZA.ṬU širgaru, ^asāndu, obviously the chief colours, the last five being blue, crystal, white, green, and red, leaving us with black as the remaining stone. Since the commonest black substance for making seal-cylinders is haematite (*SC.* 6), ^ašadānu will thus again coincide with this form of iron.

That ^ašadānu is a material for seals (*CT.* xxiii, 1, 10) is also shown by a rite in which the door of the sick man is to be sealed (*barāmu*) *ina* ^akunuk ZA.SUḤ u ^ašadānu(nu) 'with a seal of vitriol-(stained) stone and šadānu'. (Cf. also the seal *CT.* vi, 11, Bu. 91-5-9, 285, a, l. 4.) On the other hand, in prescriptions in *MT.* the solid haematite (^ašadānu, *KA.GI.NA*)² does not occur as a drug; it is ^aKA and ^aKA.GI.NA. *DIB.BA*, ochre and magnetic iron ore, which are both sufficiently friable to be used in medicine.

This base ^aKA should indicate the various Assyrian words for the different iron ores. Rutley says (319) that the chief iron ores are the oxides (red haematite, brown haematite, magnetite): that the natural oxides and silicates are used in the manufacture of paints, e.g. ochres are hydrated ferric oxides, sienna and umber are silicate of iron and aluminium, containing iron and manganese, and 'reddle' is the most earthy variety of haematite (*ib.* 323). Limonite (hydrated oxide of iron) provides a yellow ochre (*WM.* 134), or brown haematite mixed with aluminous and other substances passes into yellow ochre (*EC.* 809), which, I presume, can merge into the Assyrian 'white ochre' (^aKA.PAR). 'In the Jubbulpore district mineral paint-works are utilizing the soft haematites of Jauli and are drawing supplies of yellow ochre from the Panna State' (*SMR.* 52). Now, since we have already suggested

¹ Herzfeld (*AMaI.* iii, 2, 65, 1931) and Scheil (*MMAp.*, 1929, 29) have both overlooked this identification in *OTC.* (1925).

² ^aKA.GI.NA 'the KA stone defined by GI.NA'. This adjective *GI.NA* is distinct from the ordinary words for 'hard' as applied to stones, *AŠ* and *AŠ*. *AŠ* (see No. 15(b)). We might perhaps seek the explanation in the parallel *KŪ.GI* 'gold', lit. 'the bright, defined by *GI*', not so much 'true' or 'hard' as 'heavy', just as ^aKA.GI.NA.DIB.BA, the magnetic iron ore, is the 'heavy, grasping iron'. But possibly it means only 'the stone of true voice' (p. 86).

that there is reason to see the softer form of haematite or iron ore in ^aKA, we may accept it here as the ordinary red paint or red ochre. Sennacherib used burnt brick, ^aKA, and ^auknû in building his palace (King, *CT.* xxvi, 24, 42), the blue of the latter suggesting the contrast 'red paint' for the other. Esarhaddon (Prisms A and C, vi, 3) built his smaller palace *nibiû pasku ša* ^aKA ^auknû, describing an arch in the lines following as 'like the rainbow' i.e. probably not glaze (as Winckler, *KB.* ii, 139), but paint (e.g. the painted bricks of Anp., *AAA.* xviii, 82). The red in the palace at Til-Barsip discovered by M. Thureau-Dangin, as identified by M. A. Granger (*RA.* 1933, 150) is an ochre or natural mixture of clayey substance and oxide of iron.

Further evidence about ^aKA as definitely red is found in Sargon's Khorsabad Inscr., 142, ^aKA occurring where ^asându ('red stone')¹ might be expected: ^aKA, ^auknû (blue), ^aPAR. AŠ (white), ^aMUḪ. AŠ. GÌ. GÌ *digili* (read thus) (arsenic yellow), ^aPAR. AŠ² (white), ^aširgaru (green). Negative evidence is all in favour that ^aKA is red, since we find ^aKA. PAR 'white KA', ^aKA. GÍG 'black KA', ^aKA. SIG₇ 'yellow KA', but no ^aKA defined by DIR 'red'. Finally *KAR.* 184, 38 shows that ^aKA is the softer and soluble iron ore of a blood-red colour, in a ritual against a ghost, with headache, &c., *NA. BI* ^{ku}šahhî *talabbaš(aš)* ^aKA *SAK. KI-šu te-iš-ši-ma dâmi-šu ta-tab-bak* 'that man thou shalt dress in a šahhû-cloth, spread KA-stone on his temples, let its "blood" flow'. Cf. Pliny (*NH.* xxxvi, 25): 'the magnet called haematites, a stone of a blood-red colour, and which, when bruised, yields a tint like that of blood, as also of saffron.' A Syr. MS. (*HS.*, ii, 15) says that it produces a liquid as red as blood. Diosc. (v, cxliii) says that the best is that which breaks easily, and is either of blood colour or black; (not, however, ^asalamdu (= basalt) in Esarh. (Meissner-Rost, *BA.* iii, 257, 22 ff.) 'silver, gold, copper, lapis (blue), ^aGÍŠ. ŠIR. GAL (marble, white), ^aša-lam-du (black), ^aašan (matrix of garnet), ^aalal-lum (limestone), *pîlu pišû* (white limestone)). ^aKA is used also as a stone for finger-rings, but not, I think, for seal-stones, which must be from the more solid ^aKA. GI. NA. ADD. i, 645, 5 mentions an *alğurit* of gold with a setting of ^aKA and ^a. . . : *ib.* 620, 2, *ḪAR. MEŠ* of gold with a setting of KA (without det.). Cf. a gift of the time of Tushratta *1 maninnu šarmu 34* ^aKA *33 ḫuraši ḫabla uknû šadi ḫurašu uḫhuz* (*TA.* 25, 54). Clay, *UMBS.* ii, 2, 105, 26 mentions 5 ^auknû 15 ^aKA 14 ^aPAR. AŠ *sihrêti*.

In *MT.* simple ^aKA is uncommon: 'with ^aKA *zakte rakte*, sharp (?)

¹ At the same time Ashurbanipal (*IA.* ii, 50, 21) speaks of decorations in *ḫašhur abi* (i.e. gall-shaped 'knops') of ^aKA, ^asându, and ^auknû, i.e. KA-stone, red, and blue, so that we may presume that the colour produced by ^aKA-stone is different from that of ^asându. For 'apple'-shaped ornaments (*bašḫuru*) in gold, silver, iron, and ZABAR, cf. *KS.* iv, 86, 29-30.

² One of these two ^aPAR. AŠ must be wrong.

fine (?) iron oxide' (thou shalt scratch his 'flies', *lamsâte*) (*AM.* 101, 3, 8). (For the provenance of *KA* see No. 8 (g).)

KA.GÍG 'black *KA*' appears to be used often as a hard stone, and so probably close to the black haematite of the seals; in *MT.* threaded and worn thus: with *hulalu* (white) *MUŠ.GIR* (green) and *PAR.AŠ* (white), on *temples* (*AM.* 20, 1, iv, 31): on *temples*, 102, 22: 104, 9: on black thread (Myhrman, *ZA.* xvi, 186, 37): when *head* smells offensively (?) (*AM.* 2, 1, 9): against *AN.TA.ŠUB* (*KAR.* 186, r. 15). Worn in ritual (*BBR.* No. 11, 28): in a virility or love-charm (*Liebesz.* 30, 40). In very early times, 1 *ZABAR SAG.KUL KA.GÍG* (*TD.* 5529: Boson, *Fr.* 23, 7). It is used as a comparison (*KAR.* 185, ii, 8: *abnu šāšu kima KA.GÍG a-* . . . 'this stone is like black haematite: [its name] is *a-* . . . (a stone for loosing the "knot" of a god, a stone *nam-* . . .)').

But it is certainly also used in powder: in *AM.* 16, 3, 12+12, 3, 6, *KA.GÍG* brayed alone in naphtha for *eyes*. (For 'black ochre' see Hill, *Theophrastus*, 310.)

KA.PAR 'white *KA*', is used in *MT.* against *AN.TA.ŠUB*, to be threaded (*KAR.* 186, r. 15): against all evil (probably worn, *KAR.* 213, ii, 23): use uncertain, for some trouble in the *pelvis* (*AM.* 52, 6, 8). (Cf. also *CT.* xiv, 17, K. 13713, 5.) In a lapidary's list, v *R.* 30, 59, i, 5 (*S.* 914). In plural, to be threaded (Thureau-Dangin, *RA.* 1921, 167). White ochre is the Terra Melia of the ancients (Hill, *l.c.*).

KA.SIG, 'yellow ochre'; worn (?), *AM.* 29, 2, 8 and 47, 3, iv, 32: one of fourteen against evil dreams (*KAR.* 213, 28), dup. K. 2409, ii, 18: also in latter, i, 10.

We have seen above how the *KA*, properly '(red) *KA*' is used so that the 'blood' can exude, and similarly that the 'black' can be powdered: the similar use of the others, 'white' and 'yellow', can be inferred. Perhaps the oxide in these cases is used to dye beads: in *AM.* 52, 6, 8 not only does the prescription contain *KA.PAR* 'white *KA*', but also *PAR.AŠ* and *PAR.AŠ.AŠ*, both of the latter hard white stones, which rather indicates that the virtue here lies in the material and not in the actual colouring, and that 'white *KA*', one white mineral, has some inherent property distinct from the two other white stones.

KA.SIG, like *KA.GÍG*, is introduced in an Assyrian description of a mineral, for comparison for *KA.AŠ.GE₄.GE₄*, a composite word 'red iron oxide+arsenic', in *KAR.* 185, r. ii, 9: *abnu šāšu kima KA.SIG u ša-di' [ri-i-šu] (10) abnu šuātu KA.AŠ.GE₄.GE₄ [šum-šu]* 'this stone (is) like yellow ochre, and a pillow (?) [of the head]: this stone's name is] "iron oxide+arsenic".' This may be either 'cube-ore', a mineral arseniate of iron, a 'hexahedral licrocone-malachite', olive-

¹ Cf. l. 12, and *Aram. sadyā* 'pillow', which gives the crystalline shape of the substance.

green, passing into yellowish brown, yielding arsenical fumes on charcoal, and fusing 'to a gray, metallic magnetic slag, which gives an iron reaction with the fluxes' (EC. 498): or mispickel (arsenopyrite or arsenical pyrites), a compound of iron, arsenic, and sulphur, its crystals belonging to the orthorhombic system, and usually prismatic in habit; it is tin-white, but often shows a bluish, yellowish, or blackish tarnish. (WM. 89: but against this see ^aaš₇kikū, No. 4 (v).)

Another compound of ^aKA is ^aKA Marḥaši arka 'yellow (or green) mineral of iron oxide + marḥaši (pyrites)', for which see under ^amarḥaši (No. 9 (e)).

8 (g) and (h) ^aŠadānu šabitu, ^aKA.GI.NA.DIB.BA, magnetic iron; ^aŠadānu baṭṭu, ^aKA.GI.NA.TIL.LA, ferrum vivum.

'Grasping iron ore' and 'living iron ore', i.e. magnetic iron, the *magnes* of Pliny, and lodestone, his *ferrum vivum* (OTC. 125).¹ In NH. xxxvi, 25 he discusses the *magnes*, known as *sideritis* 'iron earth' (see Bostock, *ib.*); and mentions a 'male' and 'female': 'the moment the metal (iron) comes near it, it springs towards the magnet, and, as it clasps it, is held fast in the magnet's embraces'. But a knowledge of the properties of magnetic iron ore can be traced back to Aristotle (4th cent. B.C.), and of the lodestone to the Greeks of the eighth century. The *ferrum vivum* of Pliny (*ib.* xxxiv, 42) appears to have been the lodestone, which is, according to DAC. iii, 344, the name applied to those specimens of mineral magnetite which are magnetic with polarity.

The ^ašadānu šabitu is described in KAR. 185, r. ii, 14,² thus: *abnu šāšu GUL (?) DIR (?) pilūti ukal* ^aKA.GI.NA.DIB (15) *šum-šu aban kināti šāšu GI.NA lid(?) -bu-ub* (16) *mimma ša ina pi-šu uššū kiitu u sartu ana* ^{ilu}Šamši (17) *ušanna amelu na'du-ma šāšu iḫzi-šu* (18) *kašpa kab-bit (?) . . . -ma*. The translation of l. 14 is difficult, owing to the condition of the text, the only satisfactory word herein being *ukal* 'it holds', referring to the magnetic attraction. Tentatively I would suggest 'This stone is full of covetousness (?): it grasps *pilūti*: its name is *KA.GI.NA.DIB* ("grasping haematite")'. It is the stone of truth: let (?) him speak the truth (i.e. a pun on *KA.GI.NA*); whatever comes forth from his mouth is true, and he will reveal treason to the light of

¹ Overlooked by Meissner (*Beitr.* ii, 1932, 63): 'Was dieser Zusatz bedeuten soll, vielleicht das lebendige Spiel seines Glanzes, ist noch unsicher', and 'Was für eine Specialität der *šadānu šabitu* bezeichnet, ist wieder noch nicht auszumachen; vielleicht ist er ein "in Gebrauch genommener, bearbeiteter" Stein'.

² *GUL(SUN)* = *ḥabātu* 'to plunder', *kaḫū ša ameli* 'hold prisoner (of man)', *karānu* 'to hold back' (D., 429). 'Being full of covetousness(?)' (*DIR* = *malū*, 'to be full of') can be paralleled by *malū puluḫti*, *kuzbu u lalā*, *kuzbu u ulša*, and *rišāti* (MA. 541). *Pilūti* is difficult: one would have hoped to find some word suggesting 'iron' here: we cannot refer it to *pilū* 'dark(-red)', applied to blood (AM. 50, 4, 17: *AṣSL*. 1930, 9, n. 1) indicating the dark red colour of the stone.

open day; he will be a famous man; his own knowledge¹ will acquire (?) money . . .' (i.e. owing to the acquisitive power of the magnet).

Cf. Pliny (*NH.* xxxvii, 60), where he says that the possession of haematite reveals treacherous designs on the part of barbarians, and that 'Zachalias of Babylon' says that it ensures success in petitions, plays a part in lawsuits, and that to be rubbed with it on the field of battle produces beneficent results. Add to the above *KAR.* 14, 24-5, **KA.GI.NA ša ina mâti nukurti rigma ezza taškumu* 'O Haematite, which didst utter a loud cry in a foreign land' (said of haematite, be it noted, and not of the magnet), which may perhaps explain **KA.GI.NA* as 'true voice stone', i.e. the ringing sound given out by haematite when struck. A connexion with the Sun-god (as the power of light and justice) is shown in *JRAS.* 1929, 284 (Mullo-Weir) **KA.GI.NA šad-da-an-nu na-ra-am* ^{ilu} *Šamši daiāni š[i-ri(?)]* 'O Haematite, (stone) of the mountains, the delight of Shamash, the s[upreme (?)] judge'. He who possesses a haematite seal 'will destroy' (*KAR.* 185, r. i, 10): the Syr. of *HS.* ii, 160 calls haematite 'gracious'.

In *Man.* 1928, 13, I adduced, as proof that **KA.GI.NA.DIB.BA* was magnetic iron ore, the occurrence of this mineral in two magical rituals for sexual intercourse (published in *LZ.* 35, 15 and 43, 13). As may be seen, Ebeling did not translate this mineral at all, and his translation for the complementary *AN.BAR* as 'Magnesitstein (?)', apparently by confusion with an incorrect and antiquated translation of *A.BĀR*, *abarū*, was very far from the mark. The text runs: 'Ritual: Thou shalt put powder of magnetic iron ore (and) powder of iron into *būri*-oil, recite the incantation seven times; [the man] shall rub [his penis therewith], the woman her uterus, and they shall copulate': and 'Ritual; thou shalt powder magnetic iron ore, mix with *būri*-oil, recite the incantation seven times, his *abunnatu* (sexual part?) rub herewith: [powder of iron] rub, mix with *būri*-oil, recite the incantation seven times, the sexual part (?) of the woman sprinkle therewith: the man and woman shall [copulate]'. Clearly in these cases the idea is that of attraction by the magnet for the iron. G. F. Kunz, *Curious Lore of Precious Stones*, 96, relates that a negro woman in Georgia some fifty years ago sued a conjuror for five dollars which she had paid him for a piece of lode-stone to serve as a charm to bring back her wandering husband.

A similar idea is found in the charms against hatred and unpopularity, as in *AM.* 87, 1, where kelp (?), *Calendula*, hellebore, . . . and magnetic iron are to be rubbed on the unpopular man with various oils: the *Calendula*, I venture to suggest, because of its Assyrian name 'It-inclines-the-Face', the hellebore, because of its power to sneeze away evil, and the magnet because of its attraction. In Scheil, *RA.* 1921, 27, we find a love-incantation on behalf of a woman: 'the

¹ Or lit., 'possessions, property'.

šadānu(nu)-DIB.BA (magnetic iron) in her right hand, the *GIŠ.MĀ.TU AN.BAR* (the bowl of iron, not 'Ninip', as Scheil) in her left hand she holds', i.e. the one will be attracted to the other. In a ritual for sexual purposes (*LZ.* 33, 22) *ZID.ZID AN.BAR ZID.ZID KA.GI.NA.DIB.BA* *imhur-pāni, kibir-iunāri, a-na* (1, probably read *ŪḪ-iunāri* (i.e. iron 'powder' (filings), powder of magnetic iron, *Calendula*, black sulphur, probably yellow sulphur) are to be put in oil and rubbed on with incantations.

KA.GI.NA.DIB.BA is used in *MT.*; for eyes, *AM.* 12, 4, 3: 13, 6, 18: 16, 3, 14. To anoint temples, eyes, and neck, with others, including *AN.BAR* 'iron', *AM.* 97, 4, 27, dup. *KAR.* 182, 10, and *CT.* xxiii, 44, 3. For uterine trouble, bray and mix *KA.GI.NA.DIB.BA* with others in honey, *himetu*-ghee, and oil, to anoint uterus, *KAR.* 194, 2: to stay menses, on a plectrum with others, including *AN.BAR* 'iron', *ib.* 45. '[When] . . . in his anus like a woman who[se] mens[truation] . . . drink *KA.GI.NA.DIB.BA* in beer' (*AM.* 43, 1, iii, 5). As a bead, to thread on: *KAR.* 192, iv, 31: thread for pregnant woman (Thureau-Dangin, *RA.* 1921, 168)¹: thread (*BBR.* No. 11, 28): to be worn to turn evil dreams to good, *KAR.* 252, r. 5: (also doubtless to be worn), for sim., *KAR.* 213, 28. 'Haematites' is prescribed in *Diosc.* (v, cxliii) and Pliny (*NH.* xxxvi, 25) for eyes and burns, and, by the former, for strangury and menses; Sprengel (*Diosc.* ii. 655) quotes Alexander Trallianus as recommending haematite as styptic. In *SM.* ii. 90, 92, haematite is pounded and applied to eyes.

There is a punning way of writing this stone in Esarhaddon's campaign against Bāzu (*PE.* 22, 55): '120 double hours of sandy ground, thistles,² and *KA šabiti*', the *šabiti* here being properly 'gazelle'. 'Gazelle-mouth stone', never very attractive, can hardly stand as a translation.

The other mineral, *šadānu balŦu*, is obviously Pliny's *ferrum vivum*. It occurs in the mythical text *AOTU.* i, 4, 305, 44 *ūme ina māti šadānu balŦu iḫḫabbi šī lū kiam* (approximately 'the days (when) *ferrum vivum* shall be said in the land: so may it be', but the meaning is not clear). But it certainly exists as a mineral in the lists, or otherwise we might

¹ Described as *kupputu*, 'to mass', 'roll up', Syr. *k'phath*, Ethpe. = *in nodum formatum est*, v. *RA.* 1929, 73, n. 3: *AM.* 48, 1, 8, 'fruit of poppy before *uktappitu* (they have massed it)'. *KAR.* 201, r. 40, in suppository: *RA.* 1929, 73, 9 (*AM.* 7, 7, 9: 43, 5, 5: 57, 5, 13: Speleers, *Recueil*, 318, r. 37), of rolling up cantharides and root of male mandrake as suppository (no plectrum mentioned). If this is right, the Assyrian magician is dealing with the powdered magnetic ore.

² There can surely be no doubt that this word *puḫutu* means 'thistle' (*AH.* 102); Adad, the god of the wind, is invoked to fill an enemy's fields with it, i.e. to carry the thistle-down. To the instances in *AH.* add one from Legrain, *UMBS.* No. 80, 10, in a description of jewellery of the time of Nazimarutash: *2 ki-lil pu-gut-ti ḫuraši*, i.e., in the form of gold thistle-heads, not thorns, as Legrain. The thistle is reckoned among the shapes for beads (Beck, *Arch.* 1927, 28).

have been tempted to translate it differently, comparing *URUDU TIL.LA* 'living copper' (Scheil, *RA.* 1921, 51, 17).

Magnetic iron is found near Diarbekr in large quantities, *Narr.* 521: *EE.* ii, 349: S. of the Charoki Su (plateau of Diarbekr, Karaja Dagħ), the mud and sands of the Tigris banks being almost covered with black magnetic iron sand (*A.* 270): in boulders at Diurik, not far from Keban Ma'den (*Narr.* 526) and in immense quantities about 60 miles NE. of Tabriz (Mactear, *TIM.* iii, 1894, 2). Tigl. Pil. I (c. 1100 B.C.) obtains **KA*, **ħalta*, and **KA.GI.NA* from Nairi, mountainous regions to the NW. (*TP.* viii, 11), which, of course, coincides with the first of the above. Here may be added that brown haematite is found near Hit (*EE.* i, 44): red ochre from Hormuz, in the Persian Gulf (Venetian red+iron, Hill, *Theophrastus*, 311). In Persian times **KA.GI.NA* (= Pers. *axšaina*) came from Khwarizm, Chorasmii, E. of the Caspian (Scheil, *MMAP.* xxi, 8, 27).

To sum up: **KA* with its different colours white, yellow, and black, is iron ore, ochre, itself being the simple red ochre. **KA.GI.NA*, *šadānu*, is the hard haematite: and **KA.GI.NA.DIB.BA*, the 'grasping haematite', is magnetic iron ore, **KA.GI.NA.TIL.LA* being in all probability the lodestone, *ferrum vivum*.

9. The Iron Pyrites Group: the Vitriols

- 9 (a) **Pindū*, **BIL*, *aban išati*, 'fire-stone', iron pyrites.
- 9 (b) *Aban Šamši*, **DINGIR.BABBAR*, 'Sun-stone', similar?
- 9 (c) **Šargubbū*, **ŠAR.GUB.BA*, iron pyrites: **ZUR.ŠAR.GUB.BA*, decomposition of pyrites, *ianibu*, green vitriol: **GI.RIM.ŠAR.GUB.BA*, the fruit-shaped pyrites used in decorations.
- 9 (d) **ZA.SUḪ*, **šubū*, the base of the vitriols and its compounds: (1) **šubū*, **ZA.SUḪ* (alumen), sulphate of iron: (2) **šubū arku*, *ianibu*, **ZA.SUḪ.SIG*, **ZA.SUḪ.UNU.KI*, **ZUR.ŠAR.GUB.BA*, green vitriol: (3) **kibaltu*, **ZA.SUḪ.UNU.KI.GAL* (= *ianibu burru[mu]*), cobalt: (4) **uriahū*, **iarahū*, **ZA.SUḪ.DIR*, **TU*, red vitriol: (5) **šamaitu*, blue vitriol: (6) various other forms of **ZA.SUḪ*.
- 9 (e) (1) **Marḥaši*, marcasite: **KA.Marḥaši arka*, marcasite: *sāndu Marḥašitu*, aventurine: **dušū Marḥaši*, 'crystal *marḥaši*-stone' (similar).
- 9 (e) (2) **Marḥušu*, pyrites in some form, marcasite: **ħannabāḥru*, fuming sulphuric acid?

9 (a) and (b) **Pindū*, **BIL*, *aban išati*, 'fire-stone', iron pyrites: *aban Šamši*, 'Sun-stone', similar?

Note the sequence **BIL* (once incorrectly, **AN.BIL*, 'J' 41) = **pin-dū* = **aban išati* (and probably . . . *ḪUŠ*),¹ 'A' 3: 'D' 13: 'G' 18:

¹ *Mat.* 52, 2, 5 has **AN.ŠE.TIR* = . . ., followed by **ZUR.ŠAR.GUB.BA* = . . . and **sag-gil-mut* = . . ., similar to *ib.* 71, 8, **sag-gil-mut* followed by **„* (= *AN?*). **ŠI.TIR* = . . . In each case the Assyrian equivalent is lost. The fact that the *TIR* is the same in both instances prevents the suggestion that it is a mistake for *ḪUŠ* as in the Kouyunjik text above, thus rendering nugatory

'H' 36: 'I' 20: 'J' 41. In 'D' it precedes *ianibu* 'green vitriol' (cf. 'J' 41) and *saggilmūt* 'thunderbolt', sulphide of iron ('D' 13), and in 'H' and 'J' it follows *iarahu* 'red vitriol'.

In BAG. 219, *pindū* is given with the meaning 'Narbe (?)', einer Brandwunde (?), Pustel (?); — e. Stein (Feuerstein?). As a disease, *pindū* occurs commonly in the head (CT. xxvii, 18, 9: K. 2063, Bezold, Cat.: Holma, *Omen Texts*, 1, 1: Frank, *Stud.* 1, 163, 7. 9: Dennefeld, *Geburtsomina*, s.v.). A white form of *pindū* is called *garabu*, leprosy, (AM. 84, 4, r. iii, 9): *pindū* . . . can also occur on the penis (AM. 22, 1, 17), so that it is probably *herpes*, especially *herpes praeputialis*, 'an eruption of vesicles on an inflamed patch of integument' which are developed in groups, ranging in number from 2 or 3 to 20 or 30, and in size from that of the head of a pin to that of a small pea (DM. 1, 641). *Herpes zoster*, 'shingles', shows a succession of clusters of white, silvery vesicles (PC. xii, 1838, 174).

Now *aban išati* means 'fire-stone', but neither 'coal' nor 'flint' will coincide with the appearance of the *pindū* or 'herpes stone'. The same objection, however, cannot be raised against pyrites, with its peculiar granular surface: and from its very name *pyrites* 'fire-stone', with its property of giving fire when struck, as well as its relative position in the Assyrian vocabularies near 'green' and 'red vitriol', we may reasonably identify *apindū*, *aban išati*, 'fire stone' with the iron pyrites.

The 'Sun-stone' (*aDINGIR.BABBAR*, *aban Ša*-[*am-ši*] ('A' 4: 'I' 19 (?)), may also perhaps be included as pyrites, either because pyrites produces fire, or from its connexion with the false thunderbolt (the nodule of sulphide of iron) and the Assyrian comparison of the lightning which comes out of the sun 'like a thunderbolt' (No. 10 (d)). The stone is mentioned in TA. 14, 27, in the list of gifts from Amenophis IV to Burnaburiash: . . . *aban* ^{šu} *Šamši bu-a-[t]i šum-šu*, and in a lapidary's list (?), ADD. 993, 'iv', 12: 1 *pindū GI ħuraši* (re-exd.). Actually a 'sun stone' exists in mod. geology, but I doubt if this is our word (see *marḥaši*, No. 9 (e) (1)).

- 9 (c) Šargubbū, ŠĀR.GUB.BA, iron pyrites: ^aZUR.ŠĀR.GUB.BA, decomposition of pyrites, ianibu, green vitriol: ^aGI.RIM.ŠĀR.GUB.BA, the fruit-shaped pyrites used in decorations.

In 'A' 22 ^aZUR.ŠĀR.GUB.BA follows ^ašamaitum 'blue vitriol', the possible restoration AN.ŠI.ĤUŠ, the ŠI.ĤUŠ being the weapon of Ningirsu (D. 449, 191). Moreover a seal of ŠI.TIR, given by Tushratta, occurs on TA. 25, ii, 30. For AN.ŠE.TIR, see No. 21(h).

¹ Meissner, MVAG. 1904, 3, 16, reads *ša* (with HWB. 8). I have re-examined the tablet and can see only three horizontal wedges, and not the four which occur elsewhere, e.g. l. 21. But I can also see no double wedge for the middle wedge, and consequently the sign may well be *ša*, which, of course, it ought to be.

and precedes *marḥuṣum*, marcasite, pyrites (OTC. 117: see No. 9 (e) (2)); as I pointed out (*ib.* 112) on 'D' 14 it is actually equated with *ianibu* 'green vitriol'. As the green vitriol is obtained by the decomposition of iron pyrites, we have a very satisfactory line on which to work for the identification of *ŠAR.GUB.BA*.

First we must refer to another mineral, with its name based on the group *ŠAR.GUB.BA*, but also hitherto unidentified, *GI.RIM.ŠAR.GUB.BA*. *GI.RIM* = *ilhuru* 'calix of a flower', especially the peculiar and almost spherical column-base, which is described by this word *ilhuru*, on the backs of female colossi (see my article, *PRSM.* 1926, 53, and for a picture of it, *AD.* 174). Note the piece of Sennacherib's bull from Nineveh (*Arch.* lxxix, pl. lii, 122, N.) (6) u *GI.RIM.ŠAR.GUB.BA ša kima inib iNU.[UR.MA]*¹ 'and *GI.RIM.ŠAR.GUB.BA* which is like the pome[granate] fruit', i.e. the glittering balls of yellow-brown pyrites, evidently used in some rather crude adornment of the palace. Cf. *PC.* xiii, 29 (1839), pyrites being described as 'frequently found in the form of various fruits'. Esarh. also adorned his palace in the same way (*PE.* 26, 80).

We can now explain *ŠAR.GUB.BA*. Since *GI.RIM.ŠAR.GUB.BA* is the large pomegranate-shaped sphere of pyrites, and *ŠAR.GUB.BA* is the equivalent of *ianibu* 'green vitriol', we must see in the simple *ŠAR.GUB.BA* a form of pyrites, identifying, in the addition *ZUR*, some word which indicates the change of pyrites to green vitriol or copperas (protosulphate of iron). But green vitriol is actually the result of the decomposition of pyrites, and hence the application of the Assyrian equivalents for *ZUR*, such as *naḥarmuṭu* 'destruction', and others of its values indicating to 'crush' or 'beat', (*D.* 437, 7, 11, and 49 ff.), will show that the Assyrians recognized this decomposition as the origin of their substance *ianibu*.

ŠAR.GUB.BA must, therefore, mean the simple pyrites. Tush-ratta sends to Amenophis a *šallu[a]m*, the *rittu* (finger) of which is set with *ŠAR.GUB.BA* and *uḫnū šadī* (clear lapis), and its hilt (*KIN, šakar*) is a female figure of *GIŠ.ŠIR.GAL* (alabaster) set with *uḫnū šadī*, to which was added 6 shekels of gold (*TA.* No. 22, ii, 20). Another object was ornamented with *hulalu* (?) (white lead) and *uḫnū šadī* in the middle of which was *ŠAR.GUB.BA* (*ib.* i, 48 ff.): thirty-five *ŠAR.GUB.BA* stones are mentioned, *ib.* ii. 7, and one *šargubbu* in a jeweller's list (v *R.* 30, 66 g). Iron pyrites 'may possibly be mistaken' for native gold (*WM.* 94), which doubtless explains its inclusion in Assyrian

¹ I believe this is the only restoration plausible. My suggestion, *l.c.* 135, is wrong, as there is no mention of seeds. It is in my recollection that I dug out, at least once, at Nineveh a sphere of about 7 in. in diam., which I took to be a cannon ball of fairly recent centuries, which (on reconsideration) might be Sennacherib's pyrites.

jewellery. *ŠAR.GUB.BA* is one of the minerals prescribed (to be worn?) following after 'red gold' and 'yellow gold', when a man's 'god and goddess are angry with him' (*KAR.* 213, 1, 15), and it and *GI.RIM.ŠAR.GUB.BA* are included together among eight minerals for 'joy', *ib.* 4, 22. A seal of *GI.RIM.ŠAR.GUB.BA* is possible, *ADD.* 993, ii, 6.

To sum up: *ŠĀR.GUB.BA is a word for pyrites: *ZUR.ŠĀR.GUB.BA is the decomposition of pyrites, i.e. green vitriol: *GI.RIM.ŠĀR.GUB.BA is the fruit-shaped pyrites.

9 (d) (1) Šubû,¹ ^aZA.SUH², the base of the names for the different vitriols (alumen), sulphate of iron (OTC. 110).

'H', note: 'L' 99. The general meaning 'vitriol' for the groups headed by the word *ʿZA.SUH* is more easily shown with the evidence afforded by the particular vitriol *ianibu*, this becoming overwhelmingly cumulative when all the group is considered together. First, note the vitriols as known to the ancients (*Coll.* 241, 242):

Blue vitriol, sulphate of copper.

Green vitriol, sulphate of iron, and basic sulphate of copper.

Yellow and red vitriol, basic sulphate of iron.

White vitriol, sulphate of zinc, sulphate of alumina.

Stapleton (*MASB.* 322) gives Ar-Razi's list of the vitriols thus: (a) White (including alum): (b) Yellow, including 'ink vitriol', 'cobblers' vitriol', and *Sūrī*: and (c) Green, i.e., *ḡalkand*, the test of which was that when moistened and rubbed on iron it turned the latter red, and hence contained copper. *Kalkatār*, which is stated to be both red and yellow in colour, was apparently regarded as being similar to *ḡalkand*, as it answered to the same test. He notes the absence of blue vitriol from the list, but considers that it may be the 'cobblers' vitriol'. *Hist.* ii, 144 (Syr.-Arab. MS.) gives seven vitriols: (1) yellow: (2) yellow, used by goldsmiths: (3) a kind mixed with dust, used by shoemakers and dyers: (4) green (chalcantum): (5) yellow (chalcantar): (6) red, *sorī*: (7) the most noble, vitriol washed by running water (a part descends with the excavation of mines, and the sun's rays coagulate it).

So much, therefore, for the general views held by the ancients on the 'vitriols'. We can now discuss the special meaning of *ZA. ŠUH, šubû*.

It has already been shown (No. 9(c)) that *^aZUR.ŠAR.GUB.BA* = *ianibu*; that is to say, a form of pyrites = the word which I hope to show is green vitriol, the result of decomposition of pyrites. Besides this we have *^aZA.SUH* defined as 'green', 'red', and with a kind named

¹ I am usually omitting the determinative ^a before the Assyrian words for vitriols, as the syllabaries give them both ways, with and without.

² = *aban nisikti* (iv R. 18, 2 r. 9). We must relinquish *siḫru* (SAI. 9017, from a supposed reading of CT. xii, 28, 22) in favour of Meissner, *Beitr.* ii, 91, 101, *bitrānu*.

kibaltu. Accepting, for the moment, the evidence of *OTC.* 110 that we are dealing with the vitriols, we must obviously see in the simple form *šubū* (to which no special definition is given) the base of all. *Ianibu*, *šubū arku* 'green *šubū*' is the most important, and as both this and simple *šubū* occur in the same receipt (*AM.* 102, 22, 23), it is obvious that *šubū* is distinct from the green kind. Equally, the existence of a red *^aZA.SUH* eliminates that colour as a possibility for *šubū*, and we have also to omit the blue vitriol, *šamaitu*. *Šubū* is used in describing part of a building in a religious text: *ina šu-be-i u uknī rakkat* '(thy abode which) has been beautified with *šubū* and lapis' (Reisner, *Sum.-Bab. Hymn.*, 110, 26), another reason for eliminating blue. As a seal it is mentioned with the black of haematite (*CT.* xxiii, 1, 10) 'with a seal of *šubū* and *šadānu*'. It would seem, therefore, that we should accept as its meaning the 'white vitriol' of Ar-Razi (*MASB.* 348). It must be pointed out that the epithets *ibbu*, *ellu*, and *namru* (as equivalents for *PAR* 'white') for *šubū* ('L' 102-4) have no weight in this, as they are applied in the same text (*ib.* 77-9 and 86-8) to the red and blue stones, *sāmtu* and *uknū*.

This 'white vitriol', curiously enough, at all events at first sight, is said to be 'alum', a confusion shown both in the *zāje abyaz* 'white vitriol' of India (*BMM.* 63), also said to be alum, and the classical alumen. In this latter case Beckmann (*HI.* i, 180) tried to show that the ancients did not know our alum, and that it represents sulphate of iron: Moore (*Anc. Min.*, 124) disputed this satisfactorily, maintaining that 'some of the properties ascribed to alumen belong to our alum, but not in the least to sulphate of iron. . . . Thus Dioscorides says (v, 123), of the fibrous variety, which he terms *σχιστή*, that it is exceedingly white (*λευκή ἄγαν*), and from Pliny's description of this kind (*H.N.* xxxv, 52) we may infer that it was such an efflorescence as that called plume, or fibrous alum. . . . Pliny, too, speaks of alum as white—as used for whitening wool, — as being prepared for certain medicinal uses by burning it in pans until it cease to flow liquid, all which is quite inapplicable to sulphate of iron.'

On the other hand (*ib.* 123) 'the *στυπτηρία* of the Greeks, called alumen by the Romans, may in some instances have been sulphate of iron, or some other vitriolic salt besides what we call alum'. The conclusion is that the word alumen means both the sulphate of alumina and of iron.

This confusion does not appear to occur in Assyrian. If *^aZA.SUH* 'white vitriol' (as we suppose) were a form of 'alum', it is certainly different from the alum indicated by *gabū* (2 (n)), for both occur side by side in a medical receipt (to be drunk for some urinary trouble *KAR.* 193, 7, 9). *Gabū*, used in dyeing (2 (n)) must certainly be the sulphate of alumina: *šubū*, if it is accepted as the base of the vitriols, will represent the sulphate of iron.

The explanation of the confusion can be seen in the method of obtaining both: 'For many years pyritous deposits in India have been used for the manufacture of soluble sulphates of iron and copper. With the alum which was formerly obtained in quantity from the decomposed pyritous shales at Khetri and Singhana in Rajputana, copperas and blue vitriol are also obtained' (*SMR.* 46). Doubtless the Assyrians obtained theirs in the same way, one of their mines being probably those at Shap Ma'den (Kara Hissar, Siwas, *Narr.* 129).

Philologically it might be suggested that the Syr. *šaiūbā*, putridus (i.e. our decomposed pyritous shales),¹ rubiginosus (*HS.* ii, 59, Syr. text, last line) represents a borrowed form of *šubū*, but there is no original connexion between the two. Otherwise we might read *šupū* (although unlikely in the face of the form *šu-be-i*), and compare Syr. *š'phā*, in Pael, *liquavit*.

^a*Šubū* may be the equivalent of the Heb. *š'bo*,² the stone in the High Priest's breastplate. An interesting comparison can also be made with the river *nāru* *ZA.SUH* = *ŠUBA* = *nār* *in Dumuzi* (ii, *R.* 50, 12, *c-d*), 'the river of Tammuz'. Since Tammuz was, above all things, associated with the Underworld, it is possible that in this 'river of vitriol' we may see an Assyrian Styx.

Note the similarity of the word *ZA.SUH* (although, it is true, this is given the value *ŠUBA*) with the Arab. *šāḥ* 'vitriol'. Certainly Assy. *š+ḥ* becomes once at least *z* in Syriac, i.e. *hašhuru* = *hāzẖūrā*, while the Heb. *šāḥaḥ* becomes in Syr. *g'hek* so that the combination of *š+ḥ* in Sumerian might have a strange result, if borrowed. But it may be only coincidence, and it must not be forgotten that *ZA* may have to be read *IA*.

Šubū as the name of a seal-material must surely indicate the staining of a stone with this chemical, since nowadays, in order to obtain a 'Brazilian carnelian', green copperas or ferrous sulphate is used to obtain the colour (see Introduction). (Other instances of it as a seal are *AM.* 23, 7, 4: and against *lamaštu*, Thureau-Dangin, *RA.* 1921, 168: and as beads, to be threaded and worn, *BBR.*, *r.* 11, 8; *CT.* xxiii, 34, 29: 'of the right on his right hand and of the left on his left hand', Thureau-Dangin, *RA.* 1921, 164, 3.) Cf. also *KAR.* 213, 1, 18, 27, &c.: ^a*KIŠIB.ZA.SUH*, K. 9288 (Bezold, *Cat.* iii, 1000).

In *MT.* ^a*ZA.SUH* is prescribed: for *eyes*, with others in suet, *AM.* 12, 4, 4: for *temples* with many others, *AM.* 102, 22: in *urinary*

¹ Cf. *ḥanna-baḥru* 'fuming putridity?' (No. 9 (e) (2)); *ZUR* in *ZUR.ŠAR. GUB.BA* (No. 9 (c)): possibly *marḥušu*, connected with Syr. *r'hāšā* 'decay' (No. 9 (e) (2)).

² Obviously a borrowed word. 'Agate', the suggested translation, may of course be erroneous, but it is not improbable that we have here an agate dyed with vitriol.

trouble, to be drunk ('male and female ^aZA.SUH') KAR. 193, 9. Its use for eyes is paralleled in Pliny, *NH.* xxxiv, 32, with chalcitis for eyelids, pains, and films on eyes, and, applied to the forehead with a sponge, a check to defluxions from the eyes.

To sum up: simple ^aZA.SUH is 'white vitriol', a form of sulphate of iron (including the sulphate as a form of alumen), and is the base of the words for vitriol.

9 (d) (2) *Ianibu*, ^aZA.SUH.SIG₇ (^anibu should doubtless be read *ia₄-ni-bu*, ZA 'stone' having the value *ia₄*¹), ^aZA.SUH.UNU.KI ('šubû of Erech'), ^aZUR.ŠĀR.GUB.BA (decomposition of iron pyrites, see 9 (c)): i.e. 'green šubû (vitriol)', 'A' 22: 'D', 14: 'H' 10, 11: 'J', 42.

From the number of its synonyms, the most important of the vitriols, and, as its adjective shows, 'green vitriol'. Its position in the syllabaries near pyrites suggests at once that the Assyrians recognized its origin in decomposed pyrites. It is Pliny's chalcanthum (*OTC.* 111), which was prepared in pits, being held in solution in water. The water was then boiled, poured into reservoirs, and in it and over it were hung cords to which a slimy sediment attached itself in drops of a vitreous appearance, resembling bunches of grapes, which was then dried for thirty days. This substance was often taken for glass, being blue and of a brilliant lustre, and when dissolved it formed a black dye for colouring leather (*NH.* xxxiv, 32).

There is at least a similarity between *ianibu* and the Heb. 'ēnāb 'grape' (the Assyrian *inbu* probably has no connexion, *karanu* being the word for 'grape'), thus suggesting the botryoidal appearance of green vitriol. The equivalence of *ianibu* with ZUR.ŠĀR.GUB.BA 'decomposition of pyrites' equally shows its origin.

In *MT.* usually magical: with ceremonial knots to stop hair falling out, *AM.* 3, 2, 16 (perhaps because of its adhesion and black colour): bind on temples, *AM.* 102, 23, 32: 104, 10: to be worn, for favour in high places, KAR. 71, r. 19, 24 (with red *sāndu*, the black to represent the hatred to be annulled by the more pleasant red): *ia₄-ni-bu* (black) and *hulalu* (white lead) on right foot of pregnant woman against the *lamaštu*, Thureau-Dangin, *RA.* 1921, 168 (in contrast with the red and blue on the left foot). Various, *AM.* 7, 1, r. 5: 29, 2, 11: 47, 3, 30: KAR. 213, 1, 6, 8, 16 (for divine favour). Once for some stomachic (?) trouble, internally (?), *AM.* 40, 5, 20. 'Zāje *ašfara*' (yellow vitriol) is used in India for eyes, urethra, and vagina, to lessen mucous discharges, and as an internal astringent (*BMM.* 80).

¹ ^aZa-ni-bu in *CT.* xiv, 17, 1, 10, is a mistake. I have re-examined the tablet, and I think that the *za* is a badly written *iā*.

^aZA.SUH.UNU.KI (= *su-um* . . . , and *ši* (?) . . . , 'L' III, 112) 'vitriol of Erech', suggests that it may have been made at that place, but there is no reason, as far as I know, to suppose that it was a locality for pyrites (see No. 9 (d) (3)). IB. 1080 speaks of *šāj el-'Irāḳī* 'the vitriol of Iraq' of the shoemakers, which might be a corruption, or at least referable to Erech, as the Iraq origin of our vitriol.

Iron vitriol is found native in mines (R. Kirwan, *El. of Min.*, 1796, ii, 20). At Arghana Ma'den the roof and walls were of solid pyrites, diversified with stalactitic coatings of blue and green vitriol (Smyth, *YT.* 102: *Quart. Journ. Geol. Soc.* i, 1845, 334).

To sum up: ^aZA.SUH.SIG₇, *ianibu*, green *šubū*, is chalcantum, *kalkand*, green vitriol, its philological equivalence *ianibu* = Heb. 'énāb indicating the botryoidal form taken on by the substance in its manufacture. Its origin in pyrites is shown by the equivalence ZUR.ŠĀR. GUB.BA = *ianibu*.

9 (d) (3) Kibaltu, ^aZA.SUH.UNU.KI.GAL, ^aZA.SUH.ki-bal-ti, ^aianibu burrumu(?) 'great vitriol of Erech', 'green vitriol two-coloured' (? , or less probably, dark blue)?

'H' 12, 13, and note: 'J' 43. The question whether *kibaltu* is our word 'cobalt' was raised with no little courage by Mr. C. J. Gadd in a review of my *OTC.* in which I had not dared, I confess, to make the comparison, but, emboldened by his suggestion, I think it should be followed up.

'Cobalt' is 'a nickname given by the miners because it was poisonous and troublesome to them; it is merely another form of G. *kobold*, a demon, goblin' ('cf. Low Latin *cobalus*, a mountain-sprite') (Skeat, *Etymological Dictionary*). To those uninitiated in English philology like myself, the derivation sounds a little in the style of *a-non-lucendo*, but whether the Assyrian *kibaltu* is any better remains to be seen.

In our word *kibaltu* we have: (a) its Sumerian form 'great *šubū* (vitriol) of Erech', or, since the *šubū* of Erech (9 (d)(2)) = *ianibu*, 'green vitriol' (the 'grape-like vitriol'), we may read it 'great green vitriol', whatever that may mean: (b) *burrumu* (?), reading doubtful: as it stands it would be 'two-coloured' (often white and black), but if it could be related to *burumu* 'the (gray blue) firmament', we might see a blue colour in it: (c) ^aZA.SUH.kibalti 'vitriol of *kibaltu*'. *Kibaltu* itself may be either a Sumerian loan word, like *giṣaru*, *gisallu*, *ṭitalu*, or a Semitic word like *kišadu* or *lišanu*. Since KI.BAL (= *mât nukurti*, *nabalkattu*) is a well-known group, the probability is that the word *kibaltu* is borrowed from Sumerian. It does not occur elsewhere than in these Syllabaries, and there is no indication of its inclusion in the Glass-texts. How far can we compare it with what was known to the ancients?

Cobalt has long been supposed to have been known to the ancients, although perhaps only as an ore (*EC.* 461: cf. *HI.* i, 478). It has been identified in Kassite glass from Babylonia: Prof. Georg A. Koenig, quoted by Hilprecht, *ZA.* viii, 1893, 189, examined a piece of what was supposed to be lapis, and reported that in reality it was a piece of bluish opaque glass, its blue being due to cobalt. Similarly Lucas (*AEMI.* 218) says that cobalt has been recorded in Egyptian glass of the XVIIIth Dynasty (see also *Coll.* 245, and *EAA.* 660).

In the first place, the description given by *HD.* 412-13 is near enough to the source of vitriol to account for the Assyrian inclusion of cobalt amongst the iron and copper vitriols: '*Cobaltum, sive Kobaltum*, is a Sort of Marcasite, or hard, heavy, reddish granulated Stone': 'a reddish, hard Stone, that is heavy, and in Grains of the size of our Peas, that stick several of them together upon a kind of Spar or Marcasite, like Antimony': 'this Cobalt is usually found in the Silver Mines, and is a Plague to the Workmen being a dangerous Poison'. Cf. also 'This kind of pyrites (i.e. *cadmia metallica*) miners call *cobaltum*. . . . The juices, however, out of which pyrites and silver are formed, appear to solidify into one body, and thus is produced what they call *cobaltum*. There are some who consider this the same as pyrites, because it is almost the same. . . . Three kinds are found . . . black (abolite?), grey (smaltite?) and iron colour (cobalt glance?)' (H. C. Hoover, *Agricola, De Re Metallica*, 113, Bermannus). To this we may add a more modern phrasing: Cobalt-glance is cobalt-pyrites, and 'Earthy cobalt' (Cobaltic manganese) is botryoidal (*EC.* 465). The Assyrians may, therefore, be held to be justified if they really did include botryoidal 'earthy cobalt', or cobalt-pyrites alongside the *iamibu*, green vitriol, of grapelike appearance, from the decomposition of iron pyrites.

But we can go further by following up the cobalt process. Green vitriol is the result of decomposition of pyrites in the air: it is then roasted to make red vitriol. In order to make the 'safflor' or 'zaffre', the more modern smalt, from cobalt, the ores of cobalt 'are exposed to slow oxidisement in the air for a year', after which they are roasted (*EC.* 462). The modern Persian process (doubtless the same as would have been used in ancient times) is described by Houtum-Schindler (*E. Pers. Irak*, 1896, 114), who says that cobalt is obtained in Persia from a place near Kamsar (19 miles S. of Kashan), where are the celebrated cobalt mines, of dolomite, iron ore, copper pyrites, sulphide of nickel, cobalt-bloom and earthy cobalt (peroxide). The earthy cobalt is washed, and the sediment made into cakes called *lajverd-i-Kashi*. The ore is reduced in the proportion of 10 parts of earth or ore to 5 of potash and 5 of borax, pounded and made into a paste with grape treacle, and the balls of this are put with pounded quartz into an earthen pot and exposed to heat for sixteen hours. This cobalt is used

as a glaze for pots. *TC.* 1275 gives the western method, of fusing the ore with a flux of calcium carbonate or sand.

If *burrumu* is to be translated 'variegated' we might associate ^a*ZA.SUḪ.UNU.KI.GAL* 'the great vitriol of Erech' with *ilu TIR.AN.NA* (the rainbow), which is equated with Uruk, Erech (*Br.* 7665: *MANB.* ii, lxxix), with which the Syr. word *ûrâgâ*, *versicolor*, seems to be allied. The words safflor and zaffre are old words for forms of cobalt, the latter being by some connected with Arabic. It would be fantastic to compare *sabalam*, the value of ^a*ZA.SUḪ.UNU.KI*, 'L' III.

To sum up: *kibaltu*, similar in sound to cobalt, is found in the Syllabaries along with the vitriols, which are taken from decomposed pyrites, and to make colcothar, the green vitriol (collected from the cords where it forms like grapes) is roasted. The ores of cobalt, of which one kind is cobalt-pyrites, are left in the air to oxidize, and then roasted: another form of the ore is the 'earthy cobalt', botryoidal. What connexion Erech has with the making of *kibaltu* is unknown. (Whether *ešmarû* is enamel, or smalt, is uncertain: see Appendix i.)

9 (d) (4) *Uriahu, iarahu*, ^a*ZA.SUḪ.DIR*, ^a*TU*, 'red šubû', red vitriol, colcothar, sesquioxide of iron.

'H' 14, 35: 'I' 21 (?), 22 (?): 'J' 40. This is colcothar, red vitriol (*OTC.* 114) obtained by roasting green vitriol, sulphate of iron. Philologically, *a-a-ra-ḫi* occurs 'V' 12, as a syn. in Subartu for gold, with *zalhu*, *lamina* (p. 61). A word *iarah[hu]* exists with Sum. equivalent *ŠE.SAG*, *lit.* 'corn-top', (*CT.* xix, 15: K. 4422, 15: cf. *D.* 367, 94, and 105), and, since it would appear, from its appearance here, to be certainly connected with corn (*MA.* 361: *HWB.* 310), it is possible that we may see the meaning 'husk' in it, like the Greek *λεπίς* 'husk' 'flake of copper or iron', *squama*, and we may compare our *iarahu*, ^a*ZA.SUḪ.DIR*, with it. Cf. the same root in *arhu* 'scale', p. 67, in the making of copper scale. The latter must clearly be connected with the Heb. *yârêaḥ* 'moon', Aram. *yarḥâ* 'new moon', i.e. from its shape and brilliance similar to a fish's scales. Iron scale, according to Dioscorides (v, xciii, xciv), is similar to rust, which is hydrated ferric oxide, and therefore conceivably we may find some connexion between *iarahu* 'red vitriol' and *iarahhu* 'husk (?)'.

^a*TU* is used as the epithet for Ishtar's girdle (*šibbu* ^a*TU*) in her Descent, removed by the porter of Hades after her crown, ear-rings, necklace, and breast ornaments, but before her anklets, arm-rings, and her one robe (*CT.* xv, pl. 48). Obviously this is the broad external girdle which the Sumerian women wore, probably of leather, rather than of cloth, and it may be, therefore, that we should compare the

use of ^a*TU* with one of the other vitriols (i.e., the green) used by leather dressers.¹

In *MT*. ^a*TU* is prescribed in *AM*. 95, 2, 12 (dup. 97, 1, 1), with (^a)*KA. A. AB. BA* and *amitti harubi*, to be reduced in fire and pounded, mixed in cedar-‘blood’ and applied for the hand of a ghost.²

To sum up: *iarahu*, ^a*ZA.SUH.DIR* ‘red šubú’ probably connected with *arhu* ‘scale’, is colcothar, red vitriol.

9 (d) (5) Šamaïtu, mušiltu, sulphate of copper, blue vitriol.

OTC. 116. This word appears in the syllabaries after botryoidal haematite, and before ‘green vitriol’ and ‘decomposition of pyrites’ (‘A’ 21): after ‘red vitriol’ (‘H’ 15): as ^a*mu-ši-il-tu(m)*, *mu-šil-tum* (‘A’ 21: ‘C’ 14: ‘H’ 15: ‘J’ 78, as *šim-ma-ia-tū*). From its position its meaning must be similar to the vitriols taken from iron pyrites, and its name *šamaïtu* at once suggests ‘heavenly blue’ from *šamū*. In our vitriols we have still to identify ‘blue vitriol’, the beautiful blue of sulphate of copper, which is obtained by roasting sulphide of copper (copper pyrites), which the Assyrians would have found no difficulty in procuring (as Pomet, *HD*. 348, describes it ‘Crystals of a very fine Sky-coloured Blue’). This is borne out by the word *mušiltu*, which appears to be so similar to the Syr. *mūsidīn* ‘vitriolum cuprinum’, that we are justified in comparing the two, on the grounds that it is a ‘merchants’ garbling’. A parallel to this curiously mutilated form is the Assyrian *šalamtu*, which becomes in Syr. *š’ladda* ‘corpse’, and something similar occurs in Assyrian in the change of *t* to *d*, after *m* changing to *n* (e.g. *sāndu* for *sāmtu*). In *OTC*. 117 I suggested that the root of this word *mušiltu* was cognate with the Arabic *šawwala* ‘to steep, macerate’ (similar in form to *mukinnu*, from *kānu*), and this is paralleled by *Coll*. i, 241, where it is said that chalcantum, *couperose*, vitriol, was prepared with a liquor resulting from the spontaneous or provoked maceration of ores in water, and that the first product obtained by spontaneous evaporation was blue sulphate of copper.³ In India, Sir

¹ It can have nothing in common with the Syr. *ṭū*, a name for Kohl or stimmi, eye-paint (*HS*. ii, transl. 137).

² Rauwolff (*Travels*, i, 81) says that in Aleppo ‘they have still another strange Custom, which Young and Old, Men and Women, use in these Countries, viz. They make a Paste of Galls and calcined Copperas (to beautifie themselves and to keep their Eyes from Rheums) with it they blacken their Lips, and make a Ring round about their Eyes’.

³ The ‘chalcantum’ of Dioscorides was the small scales separated from the molten copper by the action of water. Bostock thinks that Pliny confused both green vitriol and blue (vi, 200), for which cf. the method of making chalcantum in a reservoir (p. 94), to which may be added (*NH. ib.*): ‘Chalcantum is also prepared in various other ways: the earth which contains it being sometimes excavated into trenches, from the sides of which globules exude, which become concrete when exposed to the action of the winter frosts. . . . It is also prepared

George Watt (*CPI.* 403) says that the people have possessed the knowledge of producing it from pyrites from a remote antiquity. Philologically, Pliny's *caeruleum* (copper ochre, or blue carbonate, Bostock, *NH.* xxxiii, 57) is a parallel. Cf. three *šamē* ('heaven-stones') in a jeweller's list (v *R.* 30, No. 5, 3).

To sum up: *šamaġtu* 'the heavenly blue', although not included in the *ZA.SUĤ* group, i.e. the iron vitriols, is allocated to a position near them in the syllabaries: that its meaning must be 'copper vitriol' is borne out by its name, and the similarity of its synonym *mušiltu* to the Syr. *múšídín* 'blue vitriol'.

9 (d) (6) Various forms of *šZA.SUĤ*.

šZA.SUĤ.ID.ZID.DA 'vitriol of the right side': *AM.* 4, 4, 8 (dup. 30, 12, ii, 4) one *šu*, to drink for stone (??), with others: *CT.* xxiii, 34, 30, dup. *KAR.* 202, ii, 22, to thread on and wear for falling hair: to bind on the right hand of a pregnant woman against *lamaštu* (Thureau-Dangin, *RA.*, 1921, 168): *CT.* vi, 11, 11, b. *šZA.SUĤ.ID.KAB.BA* 'vitriol of the left side': *CT.* xxiii, 34, 30, as above: to bind on the left hand of a pregnant woman against *lamaštu* (*RA.*, as above): *CT.* vi, 11, 12, b.

šZA.SUĤ.GAL, *šZA.SUĤ.DU*₁₃ uncertain (*CT.* vi, 11, 13-14, b).

šID.ZA.SUĤ = *si-iĥ-[rum]* (the restoration certain from the remainder of the section consisting of forms of *saĥáru*, *CT.* xii, 41, 9, v-vi). Presuming that *siĥru* is not actually to be referred to the root *saĥáru* 'go round' (and in this connexion cf. *šID.ZA.SUĤ* = *aštartu* (part of a door) (Meissner, *As. Forsch.* i, 28, 32)), it is attractive to see in it the Syr. *š'hárā*, *š'hîrā*, vitriolum, from the root *š'har* 'become black'. But if so, we have to explain the Assyrian as being the black form of green vitriol, which we may well do by making *ID* equivalent to one of its common meanings 'strength', i.e. 'strength (essence, virtue) of green vitriol = *siĥru*, the black vitriol', a black colour, of course, being the result of dyeing with green vitriol. In *CT.* vi, 11, 14, a, this word is applied to a seal-cylinder, i.e. the dyeing of an agate black with vitriol (see Introduction).

The more elaborate *šZA.TU.ID.ZA.SUĤ* means literally 'stone which effervesces under acid (dyed) with black vitriol'. The usual stones to which vitriol is applied as a dye are agate and onyx (Introd.), and consequently the Assyrian geologist suggests here that there is other material beside these, to which vitriol can be applied, which effervesces. Mr. H. C. Beck has published an instance in point, we having found shells at Nineveh which he believes were blackened with iron (*Antiquity*, 1931, 432).

in pans hollowed out in rocks; the rain carrying the slime into them, where it settles and becomes hardened.'

9 (e) (1) (a)Marḥaši), marcasite: aKA Marḥaši arḳa, marcasite: aśāndu Marḥaši(tu), aventurine: adušū Marḥaši 'crystal + marcasite'.

9 (e) (2) aMarḥušu, marcasite (?), ḥannabaḥru, fuming sulphuric acid (?).

The relationship between (a)marḥaši and a)marḥušu is by no means clear. Actually there would appear to be no proof that they are the same thing, and yet it is, at all events at first sight, probable. On the one hand a)marḥušu occurs among the vitriols in the syllabaries, and never has the additions aKA, dušū, or śāndu, as a)marḥaši has: the latter, on the other hand, is not used in such a way as to suggest that it can take the place of a)marḥušu. I propose to discuss them separately.

9 (e) 1. a)Marḥaši is very rare by itself. '25 a)marḥaši' occur, *TA*. 52, 25, but it may be that Knudtson's reading a)mar-ḥa-lim, as a form of a)marḥallu, which also occurs in this text, is the correct one, and we may have to relinquish entirely the form a)marḥaši as a separate word, finding it only in such composites as aśāndu Marḥašitu and aKA Marḥaši and a)dušū Marḥaši.

In *OTC*. 117 I identified a)marḥaši with marcasite, pyrites, but I see that von Lippmann (*EAA*. 388) had already suggested that 'mit Marchaschi hängt vermutlich der Name Markasit zusammen'. Marḥaši (identified by Jensen, *ZA*. x, 1896, 370: Thureau-Dangin, *RA*. 1899, 74) was situated in the mountains East of Assyria,¹ and is presumably identical with Marrhasion in NE. Persia (Pauly-Wissowa, *Realencyc.*, s.v., Ptolemy vi, 4, 4: viii, 21, 14). In spite of (a) the use of Marḥašitu as an adjective, and not as a separate name for a mineral, and (b) the change from ḥ to k, the similarity of the Syriac markāšīthā, our marcasite, is too great to be overlooked:² that k or ḳ can vary with ḥ or ' in cuneiform in borrowed words is well known (cf. Markāsi and Mar'ash: the god Nusku as Našḥu, in my chapter in Woolley, *Carchemish*, ii, 139: Harran, Carrhae: Ḥilakki, Cilicia: and mod. Syrian Arab. a'ul for aḳul: see also Sachau, *Reise*, 446).

Marcasite is identical in composition with the more common iron pyrites, but distinct in crystalline form and physical characters (*WM*. 91). In the thirteenth century the name was given to any ore which had

¹ Marḥaši is mentioned in the 14th year of Shulgi (*ISA*. 331, 14). I was in error in a quotation in *OTC*. 119, about the provenance mentioned there of pyrites: the reference is to the Persian Gulf, not the Zagros (*G*. 70). Copper pyrites occur at Neem Dirra, about 60 miles NE. of Tabriz (Mactear, *TIM*. iii, 1894, 5).

² Possibly we should see a cognate in the Arab. raḳaša 'be variegated, speckled', but if so, this might compel us to relinquish the theory of a connexion with the place Marḥaši. With aśāndu Marḥaši cf. a)dušū Marḥaši = a)dušū Paraši (Scheil, *RA*. 1918, 116, 27 (*TU*. No. 36)), Paraši being identified by Jensen with Susiana (*ZA*. xv, 1901, 230: see Scheil, *ib.* 119).

a metallic appearance, esp. ores now classed as pyrites (*TC.* ii, 998). *HS.* ii, 162 (Arab.) gives seven kinds of marcasites (those of gold, silver, iron, copper, lead, tin, and red copper).

The following forms exist: (1) *aKA Marḥaši arka* (v *R.* 33, ii, 36, and cf. also *ib.* iii, 9, *aKA Marḥaši*) 'a yellow (or green) mineral of iron oxide + *marḥaši*', used in the shrine of Marduk and Šarpanitum by Agum, perhaps either pseudomorphs of limonite (hydrated oxide of iron), pyrrhotite (magnetic pyrites of bronze-yellow), or even copper pyrites. (2) *aSāndu Marḥaši* (Scheil, *RA.* 1918, 118, 99 (*TU.* No. 36)): *CT.* xxiii, 37, 9), the *aSāndu Marḥašitu* of the Glass-texts (*OTC.* pl. v, 7, and Appendix i, Sect. AA), 'red *Marḥaši*-stone' or 'spangled red stone', or 'pyrites *sāndu*-stone', the famous spangled Aventurine, imitated by the Assyrians in glass, like the Venetians (*OTC.* 119, and *Intro.*). Pliny doubtless represents this actual expression with his 'sandastros', 'sandrisitae', which he explains as a product of India and S. Arabia (*NH.* xxxvii, 28) and says that it was used by the Chaldeans in their rituals (for which cf. *CT.* xxiii, 37, 9, prescribing it to be bound on the patient's temples). In the Assyrian glass-receipt (Appendix i, AA) unfortunately the important component is mutilated: . . . *ša* (?) *-ad-da-a* is to be added to t[en] mana of simple glaze, . . . mana of unwashed salt-petre, and half a mana of *damātu*-arsenic. The Venetians were supposed to have invented aventurine in the thirteenth century (*TC.* ii, 591), so that again we must accept the Assyrians as having anticipated their invention. H. J. Powell (*Principles of Glass-making*, 26) says: 'From the cuprous oxide the rich blood-coloured ruby of Bohemian glass is obtained. The cuprous oxide passes readily into the cupric condition by the assimilation of oxygen. For this reason, in the preparation of copper ruby glass, not only must all oxidizing agents be avoided, but powerful reducing agents must be added. If the reduction is carried beyond a certain point, the spangled effect of aventurine, due to reflection from particles of reduced metal, is produced.' Similarly H. Cunynghame (*Art-Enamelling*, 123) says: 'When black oxide of copper is added in larger quantity, as say 6 per cent., and then, when melted, some iron filings are added and slowly cooled, we obtain the sparkling mass known as "aventurine"'.

9 (e) (2) *aMarḥušu* is the more important by far. It follows 'green vitriol' and precedes 'thunderbolt (iron sulphide)' in 'A' 23, being given the equivalences *ŠU-u* (= *marḥušu*) and *ḥannabāḥru*.¹ It is possible (see further) that the . . . *ḤUŠ* of Col. i of 'D' 13 represents the last part of the Sumerian form of this word.

Whether we are to see in *aMarḥušu* a synonym of *aMarḥaši* (with

¹ This may be regarded as certain, although it depends on two fragmentary texts. See footnote to 'A', and p. 103.

Boson's suggestion (*Fr.* 25) that *marḥušu* was connected with the country *Marḥaši*, or not, there is little doubt of its connexion with 'green vitriol' which immediately precedes it in 'A' 23, and with sulphide of iron which follows, and, in consequence, there is every reason to think that it represents marcasite in some form, as having come from *Marḥaši*. But what is of more importance is the word *ḥannabāḥru*, its equivalent.¹ This is a composite word like *andu-ḥallatu* a kind of lizard ('creeping handmaid') (*PRSM.* 1926, 74) *ḥarba-bibillu* 'chameleon' (made up of *ḥarba* = Arab. *ḥirbā* 'chameleon' and *bibillu*, ?, *PRSM.* 1924, 17): *asaggil-mut* (10 (d), 'grape-stone of death'?). Now the latter part of *ḥannabāḥru* is clearly *bāḥru*,² and the verb *bāḥāru* is the same as the Arab. *bāḥara* 'to steam', it being used in *MT.* for 'fumigate', and as an adjective 'steaming (hot)' of poultices (*PRSM.* 1924, 3).

We have thus a composite word, *ḥannabāḥru*, of which the second half is the adjective *bāḥru* 'steaming', or, if we may be permitted to anticipate our evidence, 'fuming', given as equivalent to *marḥušu*, which is placed immediately after 'green vitriol', and preceding the nodules of sulphide of iron. We have already seen a large number of words in Assyrian for the various forms of vitriol, with a special *ZUR.ŠĀR.GUB.BA* meaning 'decomposition of pyrites' all arranged in the same neighbourhood in the syllabaries as well as 'red vitriol', colcothar, roasted green vitriol. Shall we be going too far in seeing in this *hapax legomenon* the Assyrian for 'fuming sulphuric acid'?

EB. (11th ed.), xxvi, 65 thus describes this acid: 'Originally prepared by heating alum, green vitriol, and other sulphates, and condensing the products of distillation, sulphuric acid, or at least an impure substance containing more or less sulphur trioxide dissolved in water, [it] received considerable attention at the hands of alchemists. The acid so obtained from ferrous sulphate (green vitriol) fumes strongly in moist air, hence its name "fuming sulphuric acid"'. And again, *ib.* 68: 'Fuming or Nordhausen Oil of Vitriol . . . has been made for centuries by exposing pyritic schist to the influence of atmospheric agents, collecting the solution of ferrous and ferric sulphates thus formed, boiling down to a hard mass and heating this to a low red heat in small earthenware retorts'.

If, then, *ḥannabāḥru* 'fuming *ḥanna*' be 'fuming sulphuric acid', what does *ḥanna* mean? The cognates are, in Heb. *ḥānan*, be loathsome: Syr. *ḥann*, sudore inquinatus fuit, *ḥūn'thā*, rancid oil (Brockelmann, 2nd ed., 243), *ḥ'nīnā* rancid, and Arab *ḥanna*, foetorem emisit, and

¹ See note on previous page.

² That the sign *ḥu*, *bak* has the undoubted value of *bāḥ* was shown by E. xiii, 10 (cf. *PRSM.* 1924, 3, note), on the grounds that *ba-aḥ-ru-su* (*AM.* 77, 1, 12) must be the same as *ḥu-ru-su* (*AM.* 41, 1, r. i, 23): *ba-aḥ-ra* (*AM.* 37, 3, 3) and *ḥu-ra* (*AM.* 51, 4, 4). To these I can add *AM.* 105, 11, *paḥ* (i.e. for *bāḥ*)-*ru-su*, 'steaming hot (put it on his ears)'.

muhnināh, that which exhales a fetid odour (see Dozy, *Supp.* s.v.). We shall be perhaps correct in seeing in our *ḥannabāḥru* the literal translation 'fuming fetidity' to describe the suffocating fumes of the acid.

That is as far as we can go with *ḥannabāḥru*. We can add a little from *a-marḥušu*. Apart from its appearance in syllabaries as simple *a-marḥušu* it occurs as *aBUR mar-ḥu-šum* = *ŠU* (i.e. *marḥušu* or *burmarḥušu*) in a list (Schileico, *ZA.* 1914, 292, 11, following *aBUR mar-ḥal-lum* = *ŠU*), and '3 *aBUR marḥuša*' are mentioned, *TD.* 5529, r. 4, which takes us back to the middle of the Third Millennium. If we are to see an Assyrian, and not a Sumerian, word in this,¹ and if we do not accept

¹ For the form *marḥušu* cf. *marḥušu*, or perhaps *iMAR.GU.NU* and *iSIM.MAR.GU.ŠU*, for the possible reading *aMAR.ḤU.ŠU*.

A problem is presented by the mutilated . . . *ḤUŠ* in 'D' 13, in the Sumerian column. This is the last line of S. 1805, *CT.* xiv, 16, apparently dup. of Rm. 339, *CT.* xviii, 26, and *LK.* 52. I append quotations from them, so far as is important for this question:

S. 1805, Col. i, following a group of 'mills', &c., beginning with *NA*:

9. <i>aNA.ŠU.ZAG.ḤI.LI.ŠAR</i>	.....	.....
10. [...] <i>ḤUŠ</i>	.....	.....

(Rest broken.)

Rm. 339, following the same group of 'mills', &c., beginning with *NA*:

12.	<i>i-lit</i> ,, (= <i>urši</i>)	<i>i-lit</i> ,, (= <i>mazukti</i>)
13.	<i>pi-in-du-ū</i>	<i>aban i-šat</i>
14.	<i>ŠU-u</i>	<i>ia-ni-bu</i>
15.	<i>tar-ma-nu</i>	<i>sag</i> (= <i>AN.AN</i>)- <i>gi-il-mut</i>

LK. 52, following the same group of 'mills', &c., beginning with *NA*:

4. <i>aNA.ŠU.</i> ,, (= <i>ZAG.ḤI.[LI.ŠAR]</i>)	.....
5. <i>aAN.ŠE.TIR</i>	.....
6. <i>aZUR.ŠAR.GUB.BA</i>	<i>ŠU</i>
7. <i>aSag-gil-mut</i>	<i>tar-[ma-nu]</i>

(Cf. *LK.* 71, ll. 8, 9, *aSag-gil-mut* = . . . , *aAN.ŠI.TIR* =

These quotations should be compared with 'A' 20 ff., i.e. the duplicates on *CT.* xiv, 3 and 5, with the presumed addition of 81-7-27, 147 (pub. by Meissner, *Supp.* 27).

L. 22. <i>aZUR.ŠAR.GUB.BA</i>	<i>ŠU-u</i>	<i>ia₄-ni-bu</i>
L. 23. <i>a²mar-ḥu-šum</i>	<i>ŠU-u</i>	<i>ḥa-an-na-baḥ₂-ru</i>
L. 24. <i>aSAG.GIL.MUT</i>	<i>tar-ma-nu</i>	[<i>sa</i>] <i>g-gil-li-mut</i>

From the above: either we must see (a) [...] *ḤUŠ* = *pindū* = *aban išat* 'pyrites': or (b) *aAN.ŠE* (v. *ŠI*).*TIR* = *pindū* = *aban išat* 'pyrites': or (c) we must accept the fact that the equivalences are uncertain: or (d) we may boldly suggest that, since we are dealing with a group of words connected with pyrites and green vitriol, the [...] *ḤUŠ* is the Sumerian for *marḥušu*. This, in the face of [aMAR].*ḤU.ŠA* of *AOTU.* 1, 4, 312 (see further) does not seem probable, especially as there is nothing in the traces on S. 1805 to suggest *MAR*: and yet, if we risk presuming a form [aMAR].*ḤUŠ*, we might reasonably translate it 'red deposit' (*MAR* being *šalū* 'throw', *šakānu* 'deposit', and *ḤUŠ*, *ruššū* 'ruddy'). 'Red deposit' as a meaning for *a-marḥušu*, which, as we have seen, is almost certainly equated with *ḥannabāḥru* 'fuming sulphuric acid', fits well with the result of roasting the *ianibu* 'green vitriol', which will be colcothar, crocus, peroxide of iron, *ferri oxydum rubrum*, which is left behind in the retorts in the making of the fuming sulphuric acid.

the place name Marḥaši as its real and sole philological origin, we might compare a root *raḥašu* to the Heb. *rāḥaš* 'keep moving', particularly in connexion with *marḥēšēth* 'stewpan' with which may be associated the fuming of the sulphuric acid, or an alternative possibility is the Syr. *r'ḥāšā*, caries, which might refer to the decomposition of the pyrites. But neither are really attractive, especially as the root may not be Semitic at all (and cf. *rišutu*, PRSM. 1924, 2).

BUR is *būru*, particularly a stone vessel. There are several kinds (see Schileico, *l.c.*): it may be that this *būru*-stone-vessel, *aBUR marḥuša*, is especially to keep the 'fuming sulphuric acid'. TD. 5529, r. 7, already mentioned, runs 3 *aBUR marḥuša* | 1 *a maltum BU.DA marḥuša* | 1 *aTAK marḥuša ṭubitum DU₁₃*. In this last word there is at least a coincidence in the Syr. *ṭūbī*, a kind of rouge (colcothar being ordinarily a kind of rouge).

But a most important passage is that of Geller, AOTU. i, 4, 312: 'My royal lord stood on the *marḥuša*-stone, Ninurta, son of Enlil, and decreed its fate: [*aMAR*].*HU.ŠA KI.MU.RI GU.MU.E.?* . . . Professor Langdon has been so good as to give me the reasons in full for his translation in BE. xxxi, 29 (which Geller follows), which is obviously important for our evidence: *KI.MUR = tumru*, Br. 13432, p. 510, after Zimmern, with the dialectic form *ŠE.MUR = tumru: ŠE.MUR = KI.[MUR] = [tumru]*, AL.³ 129, 105. *ŠE.MUR.GIM = kima tumri*, SBH. 119, obv., 23. For *KI.MU.RA* see also Genouillac, ITT. ii, 41, n. 3. From Professor Langdon's excellent information, 'furnace' is obviously right. His translation '[*Mar*]ḥuša-stone! In the furnace. . .' helps us out: the reference must surely be to a knowledge of the roasting of green vitriol to obtain colcothar.

To sum up: with great caution, not on account so much of the evidence, as on account of the implications involved, we may see in *ḥannabāḥru* the value 'fuming sulphuric acid'. It is an equation to *a-marḥušu* (the marcasite associated with *ianibu* 'green vitriol'), to which is given the adj. *ṭūbitum*, perhaps Syr. *ṭūbī*, a kind of rouge, and it is referred to in a religious text as a stone put into a furnace, i.e. pyrites roasted for colcothar, which will produce the 'fuming sulphuric acid'.

10. The Geodes Group and Allied Stones

- 10 (a) *Aban erī*, *aPEŠ₄*, aetites, haematite containing another stone (calcareous spar): *aškillatu*, *aPEŠ₄.PEŠ₄*, botryoidal haematite: *aNU.PEŠ₄*.
- 10 (b) *Aban aladi*, *aṬ.TU*, the stone contained in the above: *aarzallu*, *aEL*, *auban(?) šasurri* (or *aŠU.ERI(?) šasurri*), the same: *aḍaiku*, *aNU.Ṭ.TU*, 'the killer', an abortifacient.
- 10 (c) *aBišsur atani*, *aPEŠ₄.ANŠU*, belemnite?
- 10 (d) *aSaggilmūt*, 'thunderbolt', sulphide of iron.

10 (a) *Aban erī*, *aPEŠ₄*, aetites.

'A' 17, ff.: 'B' 9 ff.: 'C' 22 ff.: 'D' 3 ff.: 'H' 19, 26 ff.: 'J' 63 ff. I am indebted to the Royal Asiatic Society for their courteous leave to quote my identification of this in *JRAS.* 1933, 885, which is here recapitulated with additions.

Von Oefele was nearly correct in his suggestion that it was *aban aladi* 'the birth stone' which was the aetites of Diosc. v, clx, used as an amulet in pregnancy (*ZA.* 1899-1900, 357). Properly this is, I believe, the *aban erī*, the 'pregnant stone'. The old idea of the aetites is that it was a stone containing another, i.e. one of the Geodes. Theophrastus (*HS.* xi) says that the most wonderful quality of stones is that of those which bring forth young, to which Hill adds a note *ib.*, (p. 27) that this refers to the aetites, one stone in the cavity of another, which is famous for its imaginary virtue in assisting delivery. Diosc. says that it is a stone which, when shaken, gives out a sound as of being pregnant with another. Pliny (*NH.* xxxvi, 39) gives four kinds, including one from Africa, soft and 'female', and one from Arabia, with a hard stone within, 'male'. These are attached to pregnant women or to cattle in the skins of animals which have been sacrificed, to prevent abortion. He also mentions (*ib.* xxxvii, 59) the 'gassinade' from Arbela, a similar stone.

Its connexion (as aetites) with the eagle is due to the belief that it was used by eagles in constructing eyries (so Pliny, *NH.* x, 4): *IB.* (130) quotes Aristotle, as saying that if the aetites is shaken the sound of another can be heard inside, and when the female eagle is about to lay, her mate places this stone on her and it relieves her. El-Ghafeki says that eagles take it to their young as a talisman. In these traditions we can surely see an echo of the Babylonian legend of Etana wherein the eagle provides Etana's wife with the *šamma ša aladi* 'birth drug' (Harper, *BA.* ii, 447, K. 8578, 12, 13). Indeed, there may be perhaps an ancient pun on the word *erū* 'eagle' and *erī* 'pregnant'.

The explanation given for the aetites that it is a Geodes, a globular mass of clay ironstone, sometimes containing another stone, or hollow, is probably correct (Bostock, *NH.* vi, 364). Its connexion with iron was apparently recognized by the Assyrians, inasmuch as the vitriols and pyrites follow aPEŠ_4 and ${}^aPEŠ_4.PEŠ_4$ in the lists.

In proving the identification of aPEŠ_4 with aetites, it would be better to begin with the reduplicated form ${}^aPEŠ_4.PEŠ_4$, with its values *iškillatu* ('A' 19: 'C' 24), *ḥandapillu* ('A' 20: 'C' 25), *š[iki]nnu*, *šikin[nu]* ('A' 19: 'C' 24) (aPEŠ_4 has also the value *issillat*, *iškillat*, 'A' 18: 'D' 4). *Iškillatu* must be the Heb. *eškōl* 'bunch of grapes', from which we should suspect a botryoidal form of stone. Bostock's 'globular mass of clay-ironstone' corresponds with botryoidal haematite: the haematites of Theophrastus is described by Hill (*op. cit.*, 164) as rising into globular inequalities, resembling clusters of grapes.¹ Actually N. of Mardin

¹ Cf. the botryitis of Pliny, *NH.* xxxvii, 55, perhaps datholite or borate of

there is 'a friable laminar rock, of a buff yellow colour, which is remarkably redolent with botryoidal haematites', which are frequently hollow or filled with calcareous spar, and so abundant as to form beds in some places (*A.* 269). Thus, there is an actual mineral found locally containing another stone, shaped like grape-clusters, which corresponds with *iškillatu* 'botryoidal form', ^a*PEŠ*₄.*PEŠ*₄ and ^a*PEŠ*₄ 'the pregnant' aetites, which contains another stone, and, from the position of the Assyrian words in the lists, adjacent to the vitriols and pyrites, almost certainly indicated thereby as an ironstone. ^a*PEŠ*₄ and ^a*PEŠ*₄.*PEŠ*₄ must be the (botryoidal) haematite containing another small stone.

Further evidence that ^a*PEŠ*₄ is hollow is shown by *KAR.* 204, 15: *Enuma* ditto *NE. ZA. ZA ša lib* ^a*PEŠ*₄ *nāri i-ba-a[n . . . ultu? . . .] a-di i-ku-ti-šu tušahhar(dr) ta-zdk ta-ša-[ru-ma ibalu]* 'When ditto a frog of the middle of a *PEŠ*₄-stone of the river [. . . from? . . .] to its (?) *ikuti* (?) thou shalt reduce, bray, bi[nd on and he shall recover]': and *AM.* 80, 1, 17: *Enuma NA su-a-lam išbat-su ta-li-la ša lib* ^a*PEŠ*₄ *tušahhar(dr) tazak ina šamni ḥalši išatti-ma ibalu* 'when a cough affects a man, the dew (?)¹ from the middle of a *PEŠ*₄-stone thou shalt reduce, bray, in refined oil he shall drink, and recover'.

Other uses of ^a*PEŠ*₄ in *MT.* are: *AM.* 1, 2, 15, for *samānu* (ringworm) in the head, to be pounded with 'dust of the *pulu*-limestone threshold of an old house (af[ar]??),² wherein *arganu*-balsam grows', and seven other drugs, to be applied after anointing with 'blood' of cedar: *AM.* 19, 1, 8

lime (Bostock). For *iškillatu*, cf. *TA.* No. 14, 65, 2 *aganu ša abni 38 iškilladu ša abni*, from Egypt (perhaps vessels or sim. in the form of grape-clusters): cf. the enamelled 'lutes, figs, and bunches of grapes' from Tell-el-Amarna (Maspero, *Egypt. Arch.*, 261). Sargon took *iškila-sina* from the north (Thureau-Dangin 'jars?', *HC.* 222). Von Oefele, *l.c.*, considered ^a*PEŠ*₄ to be *λίθος σάμιος* 'probably a kind of haematite'. He calls it '*kakamabi-stone*', but this is merely *INIM. INIM. MA. BI.*

¹ *Ṭalila* (against Langdon, *RA.* xxix, 121, which can hardly be merely a synonym for a frog). The Heb. *ṭall*, Syr. *ṭallā* 'dew' may perhaps be the equivalent, and, if so, may represent the crystalline secretion in the stone (i.e. the calcareous spar). *E.* xiii, 11 suggests that we have here a stone containing another stone inside, but at the same time although *E.* read *dalila*, he proposed to read *šalila* (= embryo, Talm. Heb. *šālil*). Of the aetites Berthelot (*Coll.* 234) says, *on a même étendu le sens de ce mot aux pierres renformant un liquide. Ṭalil(?) lalara* (parallel to the gall of a snake, and the blood of an *anduhallatu* lizard for ext. use) I translated as 'liquid of a cricket' (*PRSM.* 1926, 74, n. 4), and Dr. W. J. Rutherford was so good as to draw my attention to a passage in the Works of Sir Thomas Browne (ed. Wilkin, iii, 359): 'to observe that insect which a countryman shewed Baricellus, found in the flowers of *Eryngium cichoreum*, which readily cure warts; est coloris Thalassini cum maculis rubris, et assimilatur proportionem corporis cantharidi, licet parvulum sit. Acceperat ea rusticus et singula in singulis verrucis digitis expressit unde exibat liquor'. The lady-bird is instanced by Fernie (*Herbal Simples*, 1914, 392) as secreting fluid from its legs, which will cure toothache.

² [*nī?*]-*su-tū*, very doubtful.

for muscle of temples: *KAR.* 195, r. 29: 'When a woman has borne a child and her pudenda (womb, anus, or sim.) being loosed for her does not stop her walking,¹ thou shalt reduce *PEŠ₄*-stone, bray and apply it to the place'; and for the same, mix various drugs with *PEŠ₄*-stone, anoint with oil, pour, and bind on the surface of her pudenda (*ib.* 30). The aetites is 'proper to stop Loosenesses and Hemorrhages, taken inwardly' (*HD.* 411). *Liquor ferri persulphatis* is an excellent styptic: the sulphate is used as an injection for urethral and vaginal inflammation and prolapse of the rectum (*P.* 531). *Ferri persulphas* may be obtained from powdered red haematite with oil of vitriol (*EC.* 743).

With *aPEŠ₄* as the aetites, and *aPEŠ₄.PEŠ₄* as the reduplicated *aPEŠ₄*-stone with botryoidal formation, we can consider the synonyms.

Issillat, a synonym for *aPEŠ₄* ('A' 18: 'D' 4), possibly the Heb. *šālāl* 'collect' (Dalman, *Aram.-Heb. Wörterb.*, 405), *šēlēl* in *šēlēl šēl bēšm* 'ovary' and Syr. *šellēthē da-d'mā* 'drops of blood', the Assyrian *š* having become *s* by doubling; but this is not certain, for although forms like *ikribu* from *karābu* exist, forms like *issillatu* are not so easy. *Erimmatu* ('C' 22) (= *aPEŠ₄*) as 'case-tablet', exactly fits the geodes, as any one who has seen the reddish-brown stone tightly enclosing the smaller like a case-tablet, will recognize.²

Another equivalence, of uncertain textual reading, is *la-ḥi-ia₄* (i.e. *tāk-na-te*, [*la-ḥi-ia₄* (i.e. *tāk-na-tum* (= *aPEŠ₄* ('C' 22, 'D' 4)), and *a-la-ḥi-ia(?)*-*tāk(?)* (or *na?*)-[*tī*], *a-la-ḥi-ia*-[*na-tī*] (= *aḥḥḥur* or *ḥḥḥur atani* (*tāni*), H '19', 'J' 70). The reading depends entirely on the *ia* of 'J' 70 (Matoush) since the *tāk* of the others can also be read *ia₄*. If it were *laḥi taknati*, we might consider it as a double word made up of *lāḥu* 'germ' (embryo within the womb?) and *taknati* 'care': but the *ia* of Matoush is definitely against this. Moreover, although in one case the word is a synonym for *aPEŠ₄* which means the 'pregnant stone', we have (as the other case) no such meaning for *aḥḥḥur atani*. *Laḥianatu* is unknown; *laḥantu* means some kind of a vessel, conceivably likened to our hollow

¹ My translation in *JRAS.* 1933, 889, was wrong. Cf. also *AM.* 14, 9, 5 + 44, 3, 7 [enuma abun]nat-su paṭ-rat *aPEŠ₄.ANŠU* ⁴*EL* ⁴*GUR*₅ *ḥurāšī* . . . 4 *šammēpī* *anāṭti ešēniš tazak ina abunnat-su tunatak* 'if a man's pudenda (anus, or sim.) is loosed, thou shalt bray *ḥḥḥur-atani* mineral, *Crataegus Azarolus*, henbane, pine-gum . . . these four drugs thou shalt bray together, pour into his pudenda (anus)'.

² *Erimmatu* = *aḥi abni*, 'H' 41: 'J' 76, i.e. 'father of a stone', i.e. our geodes, as being like a case-tablet. But for *aḥi abni* there are also the equivalences *aḥbu*, and *epirru* ('H' 39, 40). *aḥbu* is one of three stones used in a pavement by Sennacherib (Luck. *Senn.*, 133, 83), the other two being *ašnan* (matrix of garnet (?), No. 21(h)), and *TUR.MI.NA.BANDA* (breccia). *aḥbu* occurs with tamarisk, *CT.* xiv, 16, 93084, 4, and probably *AM.* 85, 2, 10, where it is apparently prescribed for eyes. Cf. *ina šadī(i) sa-a-bi* . . . in the Zū-myth (K. 4628, iv, R. 14, 4). The third equivalent *epirru* must be connected with *epēru* 'cover, protect' in its quality as equivalent of *erimmatu*.

stones, geodes and belemnite. Nothing can be said definitely except that the common synonym shows some similarity between ^aPEŠ₄ and ^abiššur atāni. Šikinnu (= ^aPEŠ₄.PEŠ₄), 'A' 19, 'C' 24, is some kind of clay vessel, but its significance here is not apparent. *Handapillu* ('A' 20, 'C' 25) is uncertain: it may be a composite word, *hamtu* being a pustule (Syr. *hemtā*), and *pillu* (= *GIŠ.TIN.BIL*, ii R. 45, 60, *e*, in a list of vines), both together perhaps in some way connected with the botryoidal form of ^aPEŠ₄.PEŠ₄.

Besides the above forms ^aPEŠ₄ and ^aPEŠ₄.PEŠ₄, there is also ^aPEŠ₄.nāri 'of the river' (CT. vi. 12, 15, *a*), occurring in MT., to be pounded and anointed on swelling, AM. 73, 1, ii, 3, dup. KAR. 192, ii, 27: 'reduced' and applied in skin disease (or sim.), AM. 44, 1, ii, 11. Probably also threaded for sim., KAR. 192, iv, 32.

There is also ^aPEŠ₄.tāmti 'of the sea' (CT. vi. 12, 16, *a*) occurring in MT.: to be applied to a swelling (or bruise?) with the fat of a mouse (?),¹ the fat of a chameleon,² &c., in cedar 'blood' (KAR. 182, 18). Is it *ši-ik-ku* . . . of 'D' 2? ^aNU.PEŠ₄, *aban la erī*, 'stone of not conceiving', 'B' 10, does not occur elsewhere. (For a summing-up see end of No. 10, (b).)

10 (b) Aban aladi, ^aŪ.TU, 'birth-stone', the stone contained in the ^aPEŠ₄ (geodes): ^aarzallu, ^aEL, ^auban(?) šasurri (or ^aŠU.ERĪ šasurri), the same: ^adaiku, ^aNU.Ū.TU, 'the killer', an abortifacient.

The equivalence of ^aŪ.TU with ^ait-ta-mir ('B' 11) brings it into relation with ^aEL and ^aarzallu ('H' 29: 'J' 66-7 (*it-te-mir*)). Somewhat fantastically *ittamir* has been connected with the aor. of i, 2 of *namāru* 'to shine'. Von Oefele compared it to *lithos iaspis* (ZA. 1900, 357-8), but it is more probably iv, 2, from *amāru* 'to see', meaning 'it has appeared', with reference to the stone within the 'pregnant stone'.³ ^aIttamir occurs once in MT. in a special way, as a bead of outstanding importance to be worn with others on a black thread on the neck of a pregnant woman against the *lamaštu*, a demon dangerous to women in childbirth: it is to be overlaid with gold, top, middle, and bottom (*appu*,

¹ For a possibility see SAI. 9197. On the meaning 'mouse' see my article JRAS. 1929, 340: Landsberger, AKSAW. xlii, 1934, 110. In the fable 'mongoose' is the proper translation for *šikkū*, as Götze saw (ZA. 1931, 79), and not 'cat' as I thought (see Landsberger, *l.c.*). The mongoose, fairly common in S. Mesopotamia, is the well-known foe of the snake, and that is why the mouse greets the snake with the words 'a snake-charmer has sent me'.

² On *aīar ilu* as 'chameleon' see No. 34.

³ Possibly this is the midwife's word immediately after the appearance of the new-born babe, since there was probably some custom of making the birth known.

ḫablu, and *išdu*, Thureau-Dangin, *RA*. 1921, 164).¹ All this suggests that the *ittamir* is a small stone which can be bored and overlaid with gold.

But *ittamir* = *arzallu* = *EL* ('H' 27 ff.), and *arzallu NITA* = *ittamir* (*itemir*) *la damku* ('H' 30; 'J' 66) and *arzallu ŠAL* = *ittamir* (*itemir*) *damku* ('H' 31; 'J' 67), and we must surely see some similarity between the mineral *EL*, *arzallu*, and the plant *EL* (*arzallu*), the *za'rur*, as I have suggested (*AH*. 53), the *Crataegus Asarolus*. The *za'rur* of the Arabs resembles the *nebk* (Lane, *Dict.*, s.v.), the *Zizyphus spina Christi*, a small spherical fruit (see 10 (d), where the *naniku*, *nebk*, is compared to the spherical iron sulphides 'like a sling bolt'). Consequently, we have again a small round stone, doubtless the stone which comes from the interior of the 'pregnant stone'. For 'male' and 'female' *ittamir* cf. Pliny on the male and female aetites (*NH*. xxxvi, 39), respectively hard and soft (for *damku* as 'soft' cf. '*kussu damiktu* 'soft seat' (*BAG*. 'easy chair') *Br*. 11159). In *MT*. *arzallu* is prescribed: on a 'bruise from an enemy' (*AM*. 77, 5, 16): to be pounded and bound on temples (*ib*. 102, 33): not medical (*ib*. 7, 1, iv, 7). Curious is Agum's inscription *ŠAL.LA akra u EL ša ina kašadi-šu nasḫu* 'valuable *ŠAL.LA*-stone ('womb-stone') and *EL*-stone ('birth-stone') whereof in its acquisition (possession) it is precious'² (v *R*. 33, ii, 41-2) which are both to be put into the shrine of (both, be it noted) Marduk and Šarpanit, with others.

'J' 63 gives another value *uban za³-šur-r[i]*. In the alternative 'H' 26, *ŠU.ERI* . . . I have re-examined the text, where *ERI*, although not clear, seems the only probability, *SI* being unconvincing. 'Finger of the uterus' would suggest the small stone within.

aNU.Ū.TU, daiku, 'the killer' ('B' 12), is doubtless an abortifacient, of which nothing is known.

To sum up 10 (a) and (b): *Aban eri*, *aPEŠ₄*, 'the pregnant stone' is the geodes, haematite, containing calcareous spar, or hollow: *aPEŠ₄*. *PEŠ₄*, the reduplicated form, equivalent to *iškillatu* 'bunch of grapes', is the botryoidal haematite, similarly hollow or containing a small stone: to these is applied the word *erimmatu* 'case-tablet', which admirably describes them. *Aban aladi*, *aŪ.TU* the 'birth-stone', will be the small stone in the above haematitic geodes, like the Arabic fruit of the *nebk*, Assyrian *naniku*, which (*ittamir*) 'appears' as if at a birth.

10 (c) *aBiššur atani*, *aPEŠ₄.ANŠU*, 'sexual part of the she-ass'. Uncertain (belemnite?).

Equivalences 'A' 17: 'C' 23 (= *purad(t)âtî*): 'D' 3 (= i.e. *purd(t)âtum*):

¹ *Ū.TU* to be brayed and applied to eyes (*AM*. 8, 7, 5), is probably not this stone at all.

² Hardly *na-az-ku*: it would strain the sense of *nazâku* to translate it 'difficult'. But *kašadi* may be *šadi* 'mountain'.

³ Is *za* a mistake for *šd*?

'H' 19 (*la-ḥi-ia-na(?)* . . .) (see p. 107): 'J' 70 (*abi-iş-şir ta-a-ni* = *la-ḥi-ia* . . .), and 71, *ka-ba* . . . (perhaps cf. *CT.* xiv, 17, i-ii, 19).

It is related to **PEŠ*₄, not only by its position in the syllabaries, but also by the common synonym *alahianati* (?) (No. 10 (a)). We may here have something like the geodes, but one which contains nothing: in other word's 'asses' geodes' which has befooled the finder. One kind of aetites contains grains of sand, another white clay or marl (*HD.* 411), also mentioned by Pliny (*NH.* xxxvi, 39).

**Bişşur atani* in *MT.* is usually prescribed for urinary trouble. It is 'reduced', brayed, and used alone to fill the middle of the penis in some urinary trouble, *AM.* 62, 1, ii, 5 (note that it is without oil or fat of any kind, and that two plant drugs are used in exactly the same way, separately, one being *dulcamara*, so that the ash must be very soft and friable). Again, this drug with seed of arnoglosson and anemone is to be brayed and poured into a woman's *muştinnu* (urethra) (the receipt preceding this being for a woman sick of *NI.NE*, drugs being put into the uterus, and the receipt following being for **styrax* brayed and mixed in oil to be poured into her urethra by a copper tube) (*KAR.* 194, 4, 11). The use of anemone indicates some retention of menstruation. Again, for *ḥiniḫti* (strangury) **bişşur atani* is prescribed with thirteen others [to be drunk], *AM.* 60, 1, 12: for when his 'middles' (above the pudenda) *TAG.GA^{pl}-šu* (rub, hurt him) whether walking or lying down, with many others (probably to be drunk) *ib.* 26: to be drunk for some urinary trouble, Lutz, *AJS^L*, 1919, 81, 38 and 82, 84. For *tooth-* or *face-ache*, with *sahlé* (*lolium*), male henbane, and *muša* (misy, sulphate of iron) *AM.* 78, 1, 29. Against *AN.TA.ŠUB*, *KAR.* 213, 2, 8. In a ritual against the approach of *lamaštu*, to be hung on neck with others, in the form **ŠA.ANŠU* (*LK.* 32, r. 8).

From the point of view of it being possibly similar to the empty geodes, the belemnite suggests itself. This is a 'tapering sharp-pointed fossil bone of extinct cuttlefish' (*Concise Oxford Dict.*, s.v.), which has been taken for a 'thunderbolt', and was called the *Lapis lyncis*, because it was supposed to have been formed from the urine of the lynx. It received its name belemnite 'from its Resemblance to a Dart or Arrow' (*HD.* 408). 'The Stone being broke, they find in its Concavity, that looks of a Horn Colour, a little dry grey Earth, without Smell or Taste. This Stone is us'd to break the Stone in the Kidney, and to expel it by Urine, being taken inwardly. It is also us'd externally to cleanse and dry Wounds. It is ground on a Marble to reduce it to Powder' (*HD.* 409). Similarly *BMM.* 87 prescribes for gonorrhoea a silica of lime which looks like the belemnite 'a fossil stone which occurs as a petrified oblong, obtusely pointed fruit, sometimes with a stalk, of

dirty grey outside traversed with dark brown furrows, and greenish white within'.¹

^a*Kaba* . . . can hardly be ^a*kabaşu* (No. 68, q.v.).

Purdatu is perhaps the Syr. *p'redtā*, granulum, connected with *parded*, friavit, but it is a poor definition for a drug, even if friable. Belemnite must therefore remain, for the present, only a possibility.

10 (d) Saggil(i)mut, 'thunderbolt', nodule of iron sulphide. (See JRAS. 1933, 890.)

On 'A' 24, it follows the botryoidal haematites (geodes) ^a*PEŠ₄* and ^a*PEŠ₄.PEŠ₄*, ^a*šamaātu* (copper vitriol), ^a*ZUR.ŠAR.GUB.BA* (green vitriol), ^a*marḥušu* (probably marcasite, pyrites) and precedes *inib karaši* (arsenic): on 'D' 15 it follows ^a*ZUR.ŠAR.GUB.BA* and precedes *inib karaši*, as on 'A': and finally, on 'H' 32 it follows the ^a*arzallu*-group ('birth-stone', the small haematite stones from the geodes) and precedes *aban lib birki ameli* (i.e. *mušū*, sulphate of copper or iron). It is spelt ^a*saggilmūt* ('A', 'D') ^a*saggilimūt* ('H'), and *sag* (= *AN.AN*)-*gi-il-mut* ('D') (as pointed out by Meissner, *MVAG.* 1905, 4, 9), so that it would appear to be a Semitic, and not a Sumerian, word. In that case, since we are dealing with botryoidal forms in its vicinity, the Syr. *s'gólā* 'bunch of grapes' suggests itself, although 'grapes of death' (*saggil-mut*) is not at first attractive.

Esarh. (*PE.* 21) says that he went to 'Bāzu, a district of remote situation, a journey of desert, a land of salt (and) a place of thirst, 120 double hours of sandy ground, thistles, and loadstone, where snakes and scorpions like ants filled the ground: 20 double hours of the land of *Ḥazū*, mountains of *saggilmūt* stone, behind me I left'. The names of the kings of these lands have frequently a possible Arab appearance, particularly *Akbaru*: *Bāzu* has long been compared with the O.T. *Bûz*: *Ḥazū* is similar in sound to El-Ḥasa, (E. Nejd) (less probably Huzwa in Yemama of this district, Hommel, *Geogr.* ii, 1926, 557): cf. also Palgrave's mention (*Cent. and E. Arabia*, i, 44) of small scorpions abounding in the sand of Jebel el-Jouf. We may thus have to look for *saggilmūt*-stone in E. Arabia.

Consider next the omens from lightning: 'If it thunders in Tammuz, and lightning *ša kima* ^a*saggilmūt ultu libbi Šamši ištanaḥiṭa* . . . [*ina lib*] *bi Šamši irub*, i.e. 'which like *saggilmūt*-stone leaps forth from the midst of the sun . . . and enters [the midst] of the sun' (Virolleaud, *Adad*, 5, 15). Now in 'A', 'D', and 'H' ^a*saggilmūt* = *tarmanu*: in v R. 41, a-b, 8+ii R. 31, No. 3, 8 *tarmanu* = *belu*, and since *belu* is a weapon

¹ *BMM.* 29 also prescribes for gonorrhoea carbonate of iron and lime occurring in small amorphous heavy irregular masses of a light or greyish-brown colour sprinkled with white.

('arrow' (?), *BAG*) and *tarmanu* is from the root *ramû* 'throw', Heb. *râmâh*, the *saggilmūt* must be something like a stone missile, such as a slingbolt. This is borne out amusingly by the plant-lists K. 8249 (*CT.* xiv, 31)+82-5-22, 576 (*ib.* 40), iii-iv:

11 *na-ni-ku*

ka-lu-u

12 *ka-lu-u ut-liš i'ašagu* | *ka-zi-ri¹ la iši inbu-šu kima tar-ma-ni*

(Since *na-ni-ku* occurs K. 8846 (*Pl.* 31), l. 29, there can be no doubt about the reading.) *Naniķu* thus = *kalû*, 'which in the common speech is thorn: it has no juice: its fruit is like *tarmanu*'. Now this exactly fits the Arabic *nebk*, the *Zizyphus spina Christi*. The *za'rur* (which resembles the *nebk*) is described by Lane (*Ar.-Eng. Lex.*, s.v.) as having a fruit with a round hard stone. As offered for sale in the Mesopotamian bazars this fruit is spherical, about the size of a shrapnel bullet, yellowish-green in colour, without juice: 'oblong, about the size of a sloe, and much eaten in Egypt and Arabia' (*PC.* xxvii, 789): the plant is thorny (hence *ašagu*). Indeed, perhaps *naniķu* may be the word *nebk*, by some curious change, paralleled by *Nannaru* (for *Nanmaru*, against Mullo-Weir, *Lex. of Ac. Prayers*, 234, who thinks it Sumerian). Everything points to *tarmanu*² being a slingstone, with *saggilmūt* similar.

In *MT.* (*saggilmūt* is threaded and worn with other stones on the neck to dissipate sorcery (*AM.* 7, 1, 6): it is one of six 'against anything evil' (*KAR.* 213, ii, 18): bound on temple (*AM.* 102, 22 and 30), in the latter case being crushed and anointed. In the fanciful text where the kosmos is likened to a smelter's furnace, the *saggilmūt* plays the part of the metal in the middle heavens (see No. 7(f)).

We can thus see in the *saggilmūt*-stone a stone which 'leaps out' of the heavens in a thunderstorm, being contained in the 'middle heavens', like a slingstone in shape, and perhaps from its death-dealing qualities to be translated 'grape-stone of death', and there is a mountain, presumably in Nejd, composed of it. 'Meteorite' or 'thunderbolt' is the obvious explanation.

But we may also have to see in it the erroneous belief that many terrestrial stones, such as nodules of iron (or even belemnites), are thunderbolts. True meteorites have, of course, long been known in the East (notably the Black Stone of the Kaaba; that at Emesa: the Phrygian Cybele: the image of Diana of the Ephesians): and falls of them are also recorded (the birth year of Mohammed, Jeremias, *Das Alte Test.*, 1930, 339: in China, c. 644 B.C. L. Fletcher, *Introd. to the Study of Meteorites*, 1908, 17: cf. *EB.* 14th ed., xv, s.v.). Actually a meteorite

¹ *Kaziru* (Syr. *ašârâ*?), from this and the passage about opium (*CT.* xiv, 22, vii-viii, 43), must be 'juice'. I was entirely wrong in my translation in *AH.* 43 (for the correction see *JRAS.* 1933, 892).

² For the form cf. *tabâštânu*, from *bâšu*.

from Nejd is preserved in the British Museum (Fletcher, *op. cit.* 69, quoting *Mineralog. Mag.* vii, 1887, 179). (For a list of early meteorites, see Arago, *Astronomie Populaire*, iv, 184). But, on the other hand, tradition in England regards the nodules of sulphide of iron which weather out of the chalk of the SE. coast as thunderbolts (*EB. Lc.*, 340). L. J. Spencer ('Pseudo-Meteorites', *Nat. Hist. Mag.* iii, 1931, 44 ff.), shows that many minerals are miscalled meteorites, especially nodules of iron pyrites, which are heavy, and when broken open show a radiating crystalline structure with brass-yellow colour. He describes the Hang-chow pseudo-meteorite as a block of limestone, which is said to have fallen there hundreds of years ago, and is now inscribed with a poem of which one interpretation shows that the stone was lit up in the sun after a great storm (cf. the Assyrian omen). Bearing this superstition about nodules of iron in mind, we can turn back to Hazû, presumably in Nejd, where the *saggilmūt*-mountain was. Pilgrim (*Mem. Geol. Surv. Ind.* xxxiv, 1908, 101) says that the limestone of Qath (Oman) is full of iron nodules, and Carter (*Journ. Asiat. Soc. Bengal*, 1859, 41: 1860, 239) says that the Arabic coast of the Persian Gulf is a sedimentary formation resting upon volcanic rocks associated with beds of rock salt, gypsum, pyrites, specular iron ore, &c. (a passage which I owe to Boson, *It.* 388, quoted under 'copper'). The Assyrian soldiery must have associated these nodules with meteorites.¹

To the above evidence that *asaggilmūt* is the meteorite true or false, we may add two points: (1) the connexion between thunderbolts and slingstones is shown on a leaden slingbolt from Samaria (Nash, *PSBA.* 1914, 279), the thunderbolt of Zeus being depicted in relief on one side, and on the other the trident: (2) perhaps we may compare the word *saggilmūt* to the Arab. *sijjīl* which are mystic stones (lumps of clay) baked by the fire of hell, whereon are inscribed the names of people for whom they were destined (Lane, *op. cit.*, 1311).²

11 ^aMušû (^amuzû), misy, sulphate of copper or (and) iron, Roman vitriol or (and) yellow copperas.

I identified this in my article *PRSM.* 1926, 38, as misy, which is either sulphate of copper or iron (Bostock, *Pliny*, vi, 198 quoting Brogniart). In the syllabaries ('B' 7: 'H' 21, 22: 'J' 59-61) its position is of little help, although it may be said to be in the neighbourhood of the vitriols (separated from them by five minerals in 'H'), and it precedes the botryoidal haematite in 'B'. There is a distinction made between

¹ To the north of Assyria at Divriki are great boulders of ironstone over a ton, which looked like great meteorites (*EE.* ii, 365).

² The phrase 'heaven will rain with stones' can hardly mean more than hail (*MANB.* No. 261) since it is for the wintry month of Sebat. So also No. 20, 5, 'When in Sebat stone comes'.

the 'male' and 'female', the explanation being that the male is *ša lib zikari* 'of the middle of the male (or penis)' and the female *ša lib [ŠAL]* 'of the middle [of the female, or uterus]', apparently referring more to the male and female diseases of the name *mušū* (gonorrhoea) than to the mineral itself. (For 'male' *mušū* see *TL*. 153 (38).)

The word *mušū* is the same as the Heb. *mōšā* 'issue' of Lev. xv (Jensen, *KB*. vi, i, 374, 'die stinkende Absonderung der Vorhaut', and cf. Ebeling, *ZDMG*. 1920, 187, 2). From *KAR*. 193, 12-15 it must be gonorrhoea: if a man's urine is like that of an ass, like yeast (dregs) of beer, of wine, gummy varnish, or paint (*ŠE. ṬU ḥiliti*), that man is sick of *muša*. *L*. 16, *ib.*, (dup. *AM*. 58, 6, 2, as pointed out by E., xiii, 132) 'if a man's penis *utaḫḫasu* (pricks him, smarts, Syr. 'uḫsā, sting, prick), when he micturates (or?) ejects his semen . . . his heart is "caught", and he goes to a woman (and) is "bound" (impotent?), white blood (pus, gleet) continuously flowing from his penis, that man is sick of *muša*' (the treatment being *styra in oil introduced (blown) by a catheter into the penis of the patient, who is to drink *Solanum* in *mulu-tinna* beer, and in addition beer and oil are to be boiled and applied to him and a bandage containing pine and fir turpentine and juice (tops, *PA*) of *Nerium oleander* (?) in fat is to be bound at the end of his penis). Brünnow (*ZA*. 1889, 254, 11), shows that *mūšu ša libbi urulati-šu ikkiḫ ilāni^{pl} kalama ana niše^{pl}* 'an issue from the middle of his foreskin is an abomination to all the gods against men', with which cf. the Levitical tabus on issue. Finally, cf. *AM*. 62, 1, iii, 4, *lu mušu lu KU.GIG* 'either gonorrhoea or haemorrhoids' (and also *KAR*. 73, 2 compared with *L*. 18, *lu mušu lu ḥiniḫtu lu KU.GIG* 'either gonorrhoea or stranguery or haemorrhoids').

From this equivalence (*mušū* = 'gonorrhoea') we can go on to the curious puns in 'B' 7, 'H' 33, which are of great help in our identification: '*muzu*-mineral from the middle of a man's foreskin (is) the pollution of the penis of a man' (*pappaltu*, Syr. *pūlpālā*, Frank, *Stud*. i, 137: Holma, *K.*, 97,) and 'human *ḪAR* of copper (bronze) is the mineral of the middle of a man's penis' from a comparison between the 'copious yellowish-green discharge' of gonorrhoea (with smarting in micturition, *DM*. i, 541) and the appearance of sulphate of iron (*misy*), which occurs in well-defined crystals of a 'pale-green colour, readily soluble in water' (*DS*. 520). *ḪAR* in this case must mean something like 'essence', from the values *libbu* 'heart', or *tēnu* 'grind'. The yellow-green discharge of gonorrhoea suggests that sulphate of iron is more likely than the blue sulphate of copper: on the other hand, **ḪAR siparri* does seem to indicate that the Assyrians thought it was copper. No evidence is afforded by the fact that *mušū* is prescribed to be drunk, since both sulphate of copper and of iron can be taken internally. According to Pliny (*NH*. xxxiv, 31) the best *misy* sparkles like gold when broken, and has a

sandy or earthy appearance, like chalcitis, when triturated. Berthelot (*Hist.* ii, 131) identifies it with sulphate of iron, more or less oxidized and basic, resulting from spontaneous decomposition of pyrites: Bostock (*Pliny*, vi, 198, quoting Brogniart) considers it as perhaps mixed sulphate of iron and copper.¹

^aMuṣū occurs about fifty times in *MT.*: For *eyes*, alone, anoint, *AM.* 12, 3, 3+16, 3, 9: probably, with water of tamarisk 'which has been put on the fire and . . . comes forth therefrom', &c. (showing that *muṣū* is soluble in tannin and water), *AM.* 14, 3, 9: *eyes*, ext., *AM.* 12, 3, 7+16, 3, 13 (cf. 13, 3, 3): 16, 3, 4 (and drink in beer): 19, 6, 12: probably 12, 4, 4 and 18, 9, 2. For *temples*: apply, *AM.* 2, 1, 15: bind on, *AM.* 4, 6, 4 (cf. ll. 6, 11, and *AM.* 20, 1, 6, 15): ext., 14, 4, 6: 102, 1, 16, 21: 103, 22. For *ears*, fumigate, *AM.* 33, 1, 33. For *mouth* or *tooth*, *AM.* 78, 1, 29. For *scorpion-sting*, anoint in oil, *AM.* 91, 1, r. 6. For *poison* (*šimmatu*), *AM.* 92, 5, 4. For various forms of *ghostly attack*, *AM.* 16, 3, 14: 19, 1, 11: 29, 1, 5, 6 (+ *CT.* xxiii, 22): 76, 1, 2: 89, 3, 3 (+ *CT.* xxiii, 22): 93, 1, 3, 5, 7 (part dup. 70, 2+94, 7). Uncertain: on *neck*, *CT.* xxiii, 41, 1: *AM.* 4, 6, 6: 7, 1, 10: ext., *AM.* 92, 4, 5: 94, 2, ii, 19 (presumably anus): anoint with others, *AM.* 96, 4, 7: anoint in oil, *KAR.* 205, 12. Against *lamaštu*, for childbirth, bind on, (Thureau-Dangin, *RA.* 1921, 168): to keep away ^{am}*LIL.LA*, anoint babe, *KAR.* 196, iv, 43. 'Male', *AM.* 7, 1, 10: 97, 4, 10: *KAR.* 186, r. 27. Quantity, 1 šu, *AM.* 4, 4, 9: 30, 12, 5: 2 shekels (?), *AM.* 62, 1, iv, 4. Threaded as bead (coloured (?)) with this, or rolled up (?): '14 *muza*-stones', Langdon, *BE.* xxxi, 59, 19, cf. *AM.* 47, 3, 9. Note that it can be drunk in one prescription above: the instance *AM.* 82, 4, 3, which I gave in *PRSM.* 1926, 38 is probably not admissible.

In medicine the copper sulphate is used for eyes, and as an injection in gonorrhoea (*P.* 466), and ferrous sulphate as a lotion for ulceration, and as an injection for urethral and vaginal inflammation and prolapse of rectum (*P.* 531): both are soluble in water. Pliny prescribes misy for the male generative organs, ulcers of the head, in injection with oil of roses for the ears, for granulation of the eyelids, for tonsils, &c. A parallel for the Assyrian 'buckshot' receipt is found in the Indian medicine. P. C. Ray (*Hist. of Hindu Chemistry*, i, 29) quotes sulphate of copper, sulphate of iron, realgar, orpiment, and sulphur, combined with other drugs against ringworm, eczema, and leprosy; and also (i, 52) the sulphates of copper and iron boiled with oil of belleric myrabolans for turning grey hair black. *BMM.* 30 prescribes sulphate of iron for eyes, urethra, and vagina, to lessen mucous discharges: for

¹ It is worth mention that there is a mountain called Muṣī (Shamshi-Adad, 9th cent., iii, 37). This was located by Billerbeck as SW. of the Afshar Mt. in the old Sanjak of Sulimanieh (see Meissner, *OLZ.* 1914, 54), but the mines there are of antimony and orpiment (see No. 4 (q)).

piles and ulcers: and as a powerful astringent internally, and as emmenagogue. In *MM.* i, 513, 'missy' is given as the name of an oxide of copper, used by the natives of India against the toothache, and to stain their teeth black.

To sum up: *amuşû*, *μύσιν*, with a punning reference to *muşû*, gonorrhoea, for which it is used, is particularly yellow copperas, but appears to be a confusion of the sulphates of iron and copper.¹

12-13 LEAD, ANTIMONY, AND TIN

12 (a) *Abaru*, *A.BĀR*, *A.GŪG*, lead, sometimes antimony (?).

12 (b) *LIŠ.A.BĀR*, 'needles of antimony', stibnite, antimony sulphide.

13 *Anaku*, *AN.NA*, tin, sometimes lead.

There appears to have been a not unnatural confusion in ancient times between these metals. It may make discussion easier if we begin by examining certain definite differences on which we may base our consideration.

(1) *Tin*. 'Metallic tin is one of the easiest metals to produce, and it may be obtained by simply heating the oxide with charcoal' (*AEMI.* 211). The nearest probable sources of tin for the Babylonians have been discussed in 7 (a) (Kuh-i-Benan and Khorassan, Persia, and Kasrwan, Syria). Tin-bronze was well known at the end of the fourth millennium (No. 7 (a)), but, although a very few objects in tin have been discovered in Egypt (*AEMI.* 209) I believe none of Assyrian provenance have come to light.

(2) *Lead*. 'The production of metallic lead from its ores is one of the simplest of all metallurgical operations and consists essentially in merely roasting the ore' (*AEMI.* 201). It melts at 327° C. The Assyrian sources must have been Keban Ma'den (*A.* 280), or Denek Ma'den, and Ganjabad (between Kasvin and the lower end of L. Urumieh) (Mactear, *TIM.* iii, 1894, 7-9, where he describes the floors for washing the carbonate with water four times repeated).

(3) *Antimony*. 'Antimony is taken from the Mine in little Stones of different Bigness, resembling Lead Ore, with this Difference, that it is both lighter and harder' (*HD.* 358). Antimony abounds at Keban Ma'den (*A.* 280) and is reported at Alexandretta and Antioch (*Admir. Hdbk.*, Syria, 96). In Persia it is found at Kuh-i-Surmeh (Meissner, *OLZ.* 1914, 55). For its preparation it was enclosed in fat (or dough), burnt, and quenched in milk or wine (*Diosc.* v, 99) (Pliny's method is somewhat different). Actually a fragment of a vase of pure antimony (of uncertain date) was found at Tell Loh (*Coll.* 223), and M. Berthelot

¹ A note should be added on sory (Pliny, *NH.* xxxiv, 30), (*Coll.* 14) 'produit de l'altération de la pyrite, pouvant renfermer à la fois du sulfate de cuivre et du sulfate de fer basique. Le sory est congénère du misy, produit d'altération analogue, mais moins riche en cuivre.'

quotes (*ib.* 224) ornaments in antimony from a trans-Caucasian cemetery dating from the time of the introduction of iron. But reference must be made to what *AEMI.* 81 says about the rarity of antimony as a *kohl* in ancient Egypt, and it must not be forgotten that galena (a dark grey ore of lead) was one of the commonest substances in use for this purpose (see *guhlu*, in 4 (*q*)).

Our first aim is to settle that *abaru* is a metal, and not magnesite. Oppert was correct in seeing a metal in this (*Lit. Or. Phil.* iii, 85, *rm.* 3, *MA.* s.v.), and we may eliminate Hilprecht's 'Magnesit' (*Assyriaca*, i, 1894, 80) (see *OTC.* 37). The meaning of *abaru* was taken from Sargon's inscription (Lyon, *Die Keils. Sargon's*, 20-7), he having dedicated seven tablets of which he describes the materials as gold, silver, *URUDU*, *AN.NA*, *A. BĀR*, *uknû*, and *GIŠ.ŠIR.GAL*, and of these four have survived, of gold, silver, bronze, and the last which was at first suspected of being antimony, but turned out ultimately to be magnesite (*Coll.* 221) 'shining, white, opaque, compact, hard, cut, and polished', 'carbonate of magnesia'. Hilprecht identified this with the *A. BĀR*, and for a long time *A. BĀR* was accepted as 'magnesite', the comparison with the Syr. *abbârâ* (lead, or sim.), Arab. *abbâr* (collyrium, black lead) and Heb. *ôphêrêth* (lead) made by Oppert being relinquished. But 'magnesite' will not fit *MT.* or the Glass-texts, where a metal is far more suitable, and it is more reasonable, even at first sight, to identify the magnesite tablet with *GIŠ.ŠIR.GAL*, properly alabaster, (carbonate of lime), equated sometimes with *parûtu*, marble (18 (*a*)). We can therefore accept *A. BĀR* as a metal.

Probably our most secure starting point is the hymn to the Fire-god, where *erû* and *anâku* (*AN.NA*) are described as being melted together. This can only mean copper and tin, to make bronze (iv *R.* 14, *b*, 17-19), and a glance at the analyses in *UE.* ii, 289-90, will show at once that there is no question of antimony-bronze. We can therefore accept *AN.NA* as 'tin' for the moment (in spite of the evidence of cognate languages), leaving *A. BĀR* as either antimony or lead. Winckler, as will be seen, rightly identified *A. BĀR* with 'lead' (*AOF.* ii, 160 ff.).

12 (*a* and *b*) Abaru, A. BĀR, A. GŪG, lead, galena, and LIŠ.

A. BĀR, antimony.

A. BĀR, long accepted as the equivalent of *abaru*, to be treated with a certain amount of reserve, as being unconfirmed by syllabaries. *A. GŪG.* is given as the proper equivalent in the syllabaries (*D.* 579, 336), and important is the Sumerian *A. GŪG(BAR?)*. *RA* (duly translated *a-ba-ri*, *KAR.* 14, ii, 15-16). *A. GŪG*, as a Sumerian group, can be split up into *A* 'water' and *GŪG*, which in its double form *GŪG*+*GŪG* (*D.* 345, 13) is *bullulu*, the same word as is used for combining tin and copper in a melt to make bronze. 'Water+melt'

is certainly more applicable to lead, with its low melting-point, and its brilliant water-like appearance, than to any other metal. In the Alchemist's Text of 1600 B.C. (Appendix II) *A.GŪG* is obviously replaced by *a₇-ba₇-ram*, and the proportions demand lead, and not antimony. Similarly, it is not improbable that *MUD.A.BĀR* (which *E.* xiii, 17, reads *uppu¹ abaru* 'a tube of *A.BĀR*', used to blow drugs into the body of a pregnant woman (*KAR.* 195, 8) is of lead, rather than antimony (despite the capacity of the Babylonians for making vases of it) (*MUD.ZĀBAR* 'a bronze tube' is more usual).

Again, a man who seeks favour is to wear a hand of *A.BĀR* made with the fingers showing, and with blue cloth attached (much like the hand worn to-day in the East (*Ebeling, MDAG.* v, 3, 41: *KAR.* 238)). Whether we accept antimony or galena as the metal more connected with the eye, it would be comparatively simple to cut a model hand out of lead.

There is also a word *RAT* applied to *A.BĀR*, which may mean 'gutter', and thus *RAT.A.BĀR*, as possibly 'lead gutter', may represent a lead coffin in a ritual against ghosts (*CT.* xxiii, 17, 27, dup. *KAR.* 21, 14): 60 (?) *šalmani* (?)^{pl} *ša tīti teppuš(uš) kint[i-š]u* (?) *ipaḥaru^{pl}-šunu RAT.A.BĀR inna(š)šū šalam marši ša GAB dišpi teppuš(uš) markas* (?) (*subat*) *gišimmari éné^{pl}-šunu taḥab ina išati tukin-šu ina kimaḥḥi kintī-šu tušnal-šunuti*: '60 (?) figures (or, dead men) of clay thou shalt make, his family (?) shall surround him: they shall be borne (in (?)) *RAT.A.BĀR*. A figure of the sick man thou shalt make of wax. Thou shalt hide their eyes with a band (cloth) of palm-fibre: thou shalt put him in the fire: in the family grave thou shalt lay them.' The ritual intends, of course, that the 60 ghostly figures which haunt the sick man shall be duly buried in the family burial ground, and so 'laid', while the sick man shall be removed out of existence by the burning of his waxen image, which they must not see, and they will haunt him no more. The covering of the eyes may have the secondary suggestion that it was customary to bandage the eyes of the dead. Owing, however, to our not being certain of the meaning of *RAT*, we cannot, in this case, do more than suggest that *RAT.A.BĀR* is a 'gutter' of lead.

Sargon (*Keils. Sarg., Ann.* 201) speaks of *A.BĀR munammir aruštī-šunu* 'A.BĀR which makes their engraving² stand out', for which some form of lead (even if not plumbago) seems obvious (I am indebted to Dr. Bertram Lambert, of Merton College, for the suggestion for this: *JRAS.* 1929, 812, n. 1), i.e. picking out the characters with a black

¹ *Uppu* is also a 'drum', *BAG.* 53, a syn. of *lilissu* (*HWB.*, s.v.) the drums in Mesopotamia being made of baked clay cylinders about 4 in. in diam., with the end covered by a parchment.

² Perhaps Heb. *ḥāraš* 'engrave' (Arab. *ḥaratha*), in spite of *ḥiršu* which may be connected with a different root.

background.¹ It is probably the explanation of Job xix, 24, 'with a pen of iron and *'ôphêrêth*', i.e. (black) lead, to make the characters stand out, not molten lead to fill them (otherwise we should surely have found at least one surviving specimen by now). *ZID aruštî* 'powder of engraving' is a parallel, *AM.* 70, 2+94, 7, l. 16, dup. *KAR.* 182, r. 29, and nearly *AM.* 4, 6, 8, *JRAS.* 1929, 812 (the left horn of an ox and hart's horn 'reduced', mixed with *ZID arušte*, and the patient to be anointed therewith and with many others against some ghostly attack). According to some the Arab. *abbâr* is black lead, but others say that it only receives this name after burning (*IB.* s.v.). TP. I took 'one *imer* of *kurbâni* (lumps) of *a-ba-ri*' from Malatia (v, 39) (only 30 miles SW. of Keban Ma'den), and this can hardly be said to represent a heavy load of ordinary lead for tribute. TP. III received it from Palestine (*A. BÂR*, ii R. 67, 62). In a magician's note, K. 1293 (*ABL.* 461), after a figure of the dead man in clay and another of an evil spirit have been made, there is a mention of a copper axe, followed by '3 shekels of *A. BÂR*, 3 shekels of copper (*erû*), 4 grains of silver'. It is possible that these three represent the three colours black, red, and white, for magical purposes, but otherwise their purpose is not clear. But in spite of the uncertainties, it may be said that we have now good evidence for *A. BÂR* meaning 'lead', and *AN.NA* 'tin', which can now be applied to *MT.* where we find:

(1) *A. BÂR* occurs (a) simply; (b) in *namsidi A. BÂR*; (c) in *ŠU. SI A. BÂR*; (d) in *LİŠ. A. BÂR*.

(2) *A. GÛG* occurs simply only.

(1) (a). *A. BÂR* simply. In a receipt for head, preceding a prescription for a boy with a head full of grey hair, which suggests that it may be a hair-dye:² '*AN.NA A. BÂR AN.NE* (saltpetre) mix together, once, twice [apply]' (*AM.* 5, 1, 3). If this represents a dye, we shall probably not be wrong in seeing the same black lead in *A. BÂR* as we saw in Sargon's use of it to make an inscription 'stand out', but *AN.NA* presents perhaps a difficulty as 'tin', unless the form in which the Assyrians used it here will produce a black mark. The two other cases are difficult: . . . *ana lib A. BÂR tanadi* (in an eye-text) (*AM.* 19, 6, 3); and . . . *-ban-ti A. BÂR ina šammi* . . . (*AM.* 77, 6, 7).

(1) (b). *Namsidi A. BÂR* (to make), *AM.* 49, 4, r. 8. *Masâdu* (*tumassad*) *AM.* 64, 1, 18 (Arab. *masada* II, 'rub' *RA.* 1929, 69, n. 5) suggests that *namsidu* will be something to rub on.

(1) (c). *ŠU.SI A. BÂR* 'finger of *A. BÂR*', *AM.* 101, 3, ii, 13. Possibly suppository: cf. *ib.* i, 9, . . . *A. BÂR* applied to the anus in oil.

¹ Graphite was used in prehistoric times for polishing vases, De Morgan, *Préh. Orient.* iii, 164.

² Cf. a black hair-dye in Baghdad (Olivier, *Voyage*, iv, 38), gall-nuts, *rastouk* or antimony, cloves, vinegar.

(2) *A. GÜG*, for eyes: *AM.* 19, 6, 13 (immediately alongside *LIŠ. A. BĀR*); in warm *himetu*-ghee, *AM.* 13, 2, r. 2: bray in *irri* (opium), *AM.* 16, 1, 4: ... *A. GÜG*, *AM.* 11, 2, 25. Here there is nothing against *A. BĀR* as lead: but when we come to *LIŠ. A. BĀR* in *MT.*, which, as I think, means 'needle(s) of *A. BĀR*' we leave galena as a collyrium, and come to antimony.

(1) (d). *LIŠ. A. BĀR* occurs: for eyes: *AM.* 8, 1, 10 (bray): *AM.* 8, 6, 3 (bray): *AM.* 10, 3, 3: *AM.* 11, 2, 21 (bray); *AM.* 12, 8, 13 (bray). For ears: *AM.* 34, 1, 22: *LIŠ. A. B[ĀR]*, for penis, *AM.* 62, 1, ii, 10: uncertain, *ext.*, perhaps for stomach, *AM.* 43, 1, ii, 11. *LIŠ. idgurtu*, as I suggested in *PRSM.* 1924, 15, means 'needle', it being used as an adj. to 'mountains' (*idgurūti*, *MA.* 129), and is comparable to the Syr. *ūrd'kā* 'great needle'. With this cf. *GIŠ. LIŠ. DU*₁₃ 'small needle' = *nalpa[tu]* (*D.* 377, 9) with which latter it would be tempting to compare the Syr. *mašpīthā* 'needle', if it were permitted to assume a form *našpatu* (*š* to *l* before a labial, for which cf. *ušmānu* and *ulmānu*, *mušpalu* and *murpalu*, and even *ilsi* for *issi*). Add 1 *itgurtum ša elammaki* 'a needle of e.-(wood)' (*TA.* 22, iv, 6): 5 *TUG. LIŠ. ITT.* i, 1091, which looks much like 'clothes' needles', 4 *GIŠ. LIŠ.* 'four wooden needles' on a tablet of division of property¹ (time of Damiq-ilišu, Chiera, *UMBS.* viii, 1, 52), and *ib.* 61, ^a*ĪAR itgurti 'iršu u mimma šumšu* 'a mill, a needle, a bed, and whatever its name', property of a woman (time of Hammurabi). 'Needle of antimony' fits admirably, just as 'needle' does for 'mountain peaks' (hardly 'flachgewölbte Berge', *D.* 377, 2). Pomet (*HD.* 357 ff.) speaks of antimony as coming from mines near those of silver and lead, some full of striae like so many needles (and 'this Antimony is white and full of small Needles'). The crystals of sulphide of antimony, properly stibnite, 'have the form of long prisms, varying from the thickness of a small needle to an inch or more across' (*WM.* 79).² (See *Babyloniaca*, xiv, 1934, 102.)

Its common use as kohl for eyes in the East, as well as this distinctive use of 'needles' in its connexion certainly allows us to translate *LIŠ. A. BĀR* as the sulphide of antimony as distinct from galena. Why it was prescribed for ears is unknown: but *HD.* 359 says that antimony melted and boiled in a *ptisane* is a certain cure for the 'secret disease', which may explain its use in *AM.* 62, 1, ii, 10 for the penis. As a cosmetic antimony appears to have been used at Tell Loh as far back as the Warka period (Genouillac, *Fouilles de Telloh*, i, 47).

We have, therefore, for the moment, reached the conclusion that while *AN. NA* means properly 'tin', and *A. BĀR* lead, galena, and some form which in powder will make black marks, *LIŠ. A. BĀR* is definitely antimony, which may open a new channel for a possible

¹ Or could it mean here (single-pointed) 'forks'?

² Is the Arab *abbār* 'lead' in any way connected with *ibrah* 'needle'?

alternative meaning for *A.BAR* itself, particularly in the late Glass-texts.

In the Glass-texts of the seventh century, *AN.NA* may perhaps keep its meaning 'tin', i.e. *OTC.*, pl. 6, K. 7942, l. 17: 'To one mana of washed copper . . . ten shekels of *AN.NA*, two shekels of . . .'. It is not clear what its purpose is, but the mixture of tin and copper seems more probable than lead and copper, although by no means necessarily certain. But *a-ba-ru*, on the other hand, is not equally certain as 'lead', in these texts, and may perhaps mean 'antimony', in the two passages in which it occurs; pl. 5, iv, 15 ('one mana of *zuku*-glass, fifteen *kisal* of . . . , ten *kisal* of *a-ba-ru*, as the composition of . . .', *App.* i, U), and *ib.* v, 16 ('to one mana of *zuku*-glass, sixteen *kisal* of tutty, ten *kisal* of *a-ba-[ru]*, . . . of saltpetre, half a *kisal* of go[ld] . . .', *App.* i, DD). In this latter, which I have taken to be the Purple of Cassius (see Introduction), with its minute proportion of gold, we have in addition a small proportion of tutty, *tuskû* (properly oxide of zinc), and of *abaru*, which, if it were antimony, would fit admirably according to the ordinary components: in the former receipt, antimony suggests a yellow colour to the glass, while if *abaru* were merely lead, the proportion would be small.

This will bring us back finally to the two tablets of Sargon in *AN.NA* and *A.BAR*, the latter being thus probably 'lead'. But the former can hardly be pure 'tin' and I can only suggest that it is of tin impure enough to be satisfactory for Sargon's purpose. With this we can continue with *AN.NA*:

13 *Anâku*, *AN.NA*, tin, sometimes lead.

The cognate languages would lead us to translate *anâku* as lead: Heb. *anâk* 'plummet', Syr. *ankâ* 'black' and 'white' lead, Arab. *ankûm* 'lead', though we have seen *erû* and *anâku* are combined to make bronze (No. 7 (a)). But it is obviously lead from the Cappadocian tablets, where it is so frequent an article of merchandise (as we should expect from the proximity of the silver-lead mines at Denek Ma'den, five hours east of Keupri Keui on the Kizil Irmak (Halys) which I have myself visited). The weights of this commodity, as quoted on these tablets, certainly indicate lead, and even as late as the Assyrian Empire the weights quoted ('one talent of *anâku*', *ADD.* s.v.), down to the time of Darius (*Dar.* 249, 1: 1 mana 8 shekels of *an-na-ki* for making rings) show that lead is intended. Equally the expression *libnâte ša anâki* (Scheil, *Ann. de Tuk. Nin.*, face, 70) 'bricks of lead' will correspond to our 'pigs', hardly to tin, and the weights given, e.g. by Anp. (*AKA.* 238, 39) 'one hundred talents of *AN.NA.MEŠ*' prohibit tin entirely here. But in the middle of the third millennium we find the following: simple *AN.NA*, *ITT.* 6671: *AN.NA.ZABAR*, presumably 'tin+

bronze', *ib.* 6853: 9260: *URUDU.AN.NA.KŪN.NA*, *ib.* 9257, presumably 'copper+tin refined', bronze: simple *AN.NA.KŪN.NA* 'tin refined', *ib.* 6670; 9276: and *AN.NA.LU.LA*, presumably 'tin+lulū (oxide of zinc, pompholyx)' (alloyed?), *ib.* 6853. In *TTC.* 67 cf. (e.g.) '4 talents, 20 manas of *AN.NA ku-nu-ku*, 20+5 manas of *AN.NA ag-ga-tim*'. Irišum mentions *anakim* (*IAK.* 12, 22). Asb. (*PE.* 30, 33: Streck, 148, Cyl. C, 28) apparently overlays certain woods with '34 [talents of *AN*].*NA ħuraši rušši*, i.e. of [*AN*].*NA* and red gold. If the restoration be correct, and an alloy is intended, tin is much more probable than lead here, since an alloy of tin and gold bends readily, but one of lead and gold is very brittle (*PC.* xi, 1838, 293) (see *Zaḥalū*, No. 5 (d)).

ii *R.* 51, i-ii, 12, gives the provenance of *AN.NA* as *šadū (mātu) Ḫa* (?) *-ar-ḫa-a* and *šadū (mātu) BAR.GŪN. GŪN.NU* (cf. No. 32). The Assyrian Kings (Anp., Shalm., Sargon) took it frequently from various places in the north. For the modern provenance see p. 116, and add Lizan and Valley of Birwari, NE. of Nineveh (Gowland, *JRAI.* 1912, 273). In *MT.*: for *head* (hair?), with *A.BĀR* ('black' lead) and *AN.NE* (saltpetre), *AM.* 5, 1, 3. For *eyes* (*aAN.NA*), *AM.* 12, 4, 3. On *neck*, for pain in breast (*aAN.NA*), *AM.* 48, 4, r. 12. Ritual, (*aAN.NA*) *AM.* 71, 1, 19 (almost dup. *AM.* 39, 7): *KAR.* 213, 3, 2. The use for eyes suggests galena (lead) rather than tin.

For its particular use in the Glass-texts see No. 12 (a). Add also *KŪ.AN* = *annakam*, Urumush, Thureau-Dangin (*RA.* 1911, 139, 8), the material of a statue: cf. *KŪ.AN.NA*, Langdon, *AJS.* 1911, 139. Landsberger (*ZA.* 1929, 278) makes the *KŪ.AN* (= *amutu*) of Kul Tepe 'platin', which Lewy (*KK.* 16) rejects in favour of 'reines Zinn'. It occurs as *amudam* (*ib.* No. 10, 5). (Cf. (?) *Luck.* Senn. 110, 34: 123, 34, where Senn. sets up *zazâte pitik GU.AN.NA ša nummuru gatta-šin* 'cow-colossi made of *GU.AN.NA*, whereof the forms were brilliant'.)

To sum up: *abarū* means 'lead' 'plumbago' with a tendency to mean 'antimony', the latter not only as simple *abarū*, but especially as *LIŠ. A.BĀR* 'needles of antimony': *anaku*, the word for 'tin', is also used frequently for 'lead'.

14. THE RED STONES

^a*Sându*, (*sâmtu*), ^a*GUG*: carnelian, as well as meaning some more friable stone: without determinative, apparently cinnabar.

(For other compounds, cf. the quotation from *RA*. 1918, 118, in the first paragraph below.)

Scheil, *RA*. 1918, 118, 95 ff. (= *TU*. No. 36, r. 44 ff.) gives:

95. ^a*ZA*.^{gu-ug}*GUL*¹ = *sa-an-tu*[*m*: ^a*GUG* *ug*]-*gùn-nu*=*pi-li-t*[*ú*?].

96. ^a*GUG*.*KA* = *sur-ra-ni-t*[*um*: ^a*GUG*. . .] = *ŠU-ú*.

97. ^a*GUG*.*mar-hal-lum* [= *ŠU-u*: ^a*GUG* . . . = . . .] [*G*]*Ū* (?).
GIR = *ŠU*.

98. ^a*GUG*.? [= . . . : ^a*GU*]*G*.*ME*.*LUH*.*HA* = „*Me-luh-ha*.

99. ^a*GUG*.*Ma*[*r-ha-ši* = „*Pa-ra-ši-i*: ^a*GUG*.*G*]*u-ti-um* = „*Ku-ti-i*.

100. ^a*GUG* . . . [^a*GUG* . . .] .*RIN*.*DA* = *kub-bu-ut-tum*?

To these we must add for comparative purposes, *IM*.*MAL*.*LI*.*GUG* (*kalgugu*, red ochre, No. 2(*m*)), *IM*.*KAL*.*GUG* (mercury, from cinnabar, No. 2(*j*)), ^a*AN*.*GUG*.*ME* (Assyrian unknown, doubtful) (No. 14 (*h*)), ^a*GUG*.*DIR* (*KAR*. 184, 13, and dup. *AM*. 88, 4, r. 8), ^a*GUG*.*GI*.*RIN*.*NA* (= *Dil*[-*mun-ni-tu*?] (see No. 14 (*e*) 2)), *GUG*.*SI*.*LIM* (= *aban râme*, No. 96), ^a*GUG*.*GAM* . . ., (*CT*. vi, 11, 3 b, ^a*GUG*.*kaš*.*ŠAR* (= ^a*kaš*.*ŠAR*) (No. 61 (*b*))).

14 (a) Consider first the following red stones known anciently, particularly to the Assyrians. (I am indebted to Mr. H. C. Beck for most of this list.)

Carnelian (Beck, as beads, ‘very common’) (sard).

Red jasper (Beck, as beads, ‘fairly common’).

Red limestone (Beck, as beads, ‘not uncommon at early periods’).

Haematite (Beck, as beads, ‘uncommon, except at certain periods’).

Magnes (Magnetite, Beck says, as beads is rare).

Garnet (Beck, as beads, ‘uncommon’).

Red serpentine (Beck, as beads ‘uncommon’).

Breccia (Beck, as beads, ‘uncommon’).

Reddish granite (Kassite period, *OBI*. 49).

Miltos, *rubrica*, and *Sinopsis* (all probably some forms of ochre).

Red lead.

Cinnabar.

In examining the occurrences of ^a*sându* I think it will be seen that it has not always the same meaning:

¹ A form ^a*GUL* (= *ZA*.*GUL*, *GUG*?) occurs *TUrk*. 201, r. 5, but also *ZA*.*GUL* *ZA*.*GIN* in 304, 3.

(1) From the list of seal materials (No. 8(b)-(f)), *ašându*, the red stone, must certainly coincide with carnelian, the common (bright) red material for cylinder seals (and, it may be added, beads) as Boson (*Fr.* 43), suggests (cf. *SC.* 8). *aŠându* is hard enough to be bored, or engraved: *beliku šanta ina palaši šuma šuātu lú-na-[bar]* 'I am lord: by the boring (engraving) of the *šantu*-stone let this name be proclaimed' (Geller, *AOTU.* i, 4, 296: *KAR.* 14, ii, 28), and *ib.* 1. 31 *úma(ma) ina mâtî abnu il-la-pat (?) šantu ippalaš šî l[ú kiâm]* 'When in the land the stone is struck (?), the *šantu* is bored, so may it be!'

It is constantly recommended for beads in rituals, and we may here quote 'nine *GUG*' mentioned with 'nine *ZA.NIM*' on a text of the Gudea period (*RTC.* 203, 7), and another of a much later date (*Cyr.* 116, 1 ff.) 8 *aGUG^{pl}* . . . (2) 2 *ú-ši-in-nu huraši* (3) *pit-ka šá i^{iu} Ša-la*.

aGUG^{pl}, beads of red stone, in contrast to *ni-bu* (*ia₄-ni-bu*), black, are used in a charm against the enmity of those in high places: they are to be threaded and worn, with this ritual 'I kiss the (black) vitriol (beads), the red (beads) fill my middle: O nobleman, though thou art angry, O governor, though thou art angry; when I open the door, when I let him who is (my) enemy enter, in the eyes of my lord (it will be) as though I had done nothing' (*KAR.* 71, r. 19: Ebeling, *MDAOG.*, 1931, 33, from whose translation I differ slightly).¹ For threading, cf. also *CT.* xxiii, 34, 29: *AM.* 32, 1, [4]: wearing, *AM.* 102, 20: 'receive from the lapidary *ašându simat kišadi-ki* 'the red stone, the ornament of thy neck' (Thureau-Dangin, *RA.* 1921, 171). Various magical or ritual uses, suggesting beads or sim., *AM.* 7, 1, iv, 4: 29, 2, 7: 47, 3, iv, 30: 66, 4, ii, 1: 71, 1, 19.

So far *ašându* appears as a hard red stone for seals and beads.

(2). It is, however, used in large quantities, which suggests something other than carnelian. Keiser, *Letters*, No. 124 gives '32 (?) manas of *aGUG šiḫirti(ti)* (small, red stone), 40 (?) manas of *aGUG kabbarti* (thick, red stone), 1 mana 7 shekels of *aGUG šapilti* (deep, red stone), a total of 1 talent 13 manas 7 shekels of *aGUG* "red stone" (between 70 and 80 pounds)' which is all apparently for the temple of E. Anna, indicating perhaps jasper rather than carnelian.

(3) But it is also to be used brayed in ointments, one of which is for eyes (*GAZ ta-da-lul*, perhaps 'pound and make fine', *AM.* 18, 9, 4: *PRSM.* 1926, 43, comparing *ib.* 12, 4, 2 ff.). If it is to be applied to the eye itself, a gritty substance is hardly likely. For some form of skin trouble or ulcer, which needs a desiccative powder (including sulphur and 'boiled' gypsum, both remedies in skin troubles) to be applied (the sign *E* may be *MAR*) (*AM.* 44, 1, ii, 3 ff.: *JSOR.* 1931, 56).

¹ Read *ia₄-ni-ba bu-u-sa-ku aGUG^{pl} ma-la-a^{pl} ḫablē^{pl}-a-a. Búsaku*, Arab. *bās*, 'kiss', rather than Ebeling's '*rak(l)-sa-ku*'. The 'middle' is the pubes in these texts, the significance being that it is the seat of (sexual) love.

Now, although it would seem to be a duplicating of one of the minerals already discussed in the *aKA* (iron-stone) group,¹ the likeliest equivalence here certainly seems to me to be again one of the iron oxides. This is confirmed by the following closer definitions: *ašāndu dāmi*^{pl} 'the red stone of blood', to be threaded (either as a bead in the natural stone, or dyed with it) and bound with others on the pubes of a woman suffering from dysmenorrhoea (*KAR.* 194, i, 5). Still more definitely we find *ašāndu ša dāmu la tikta*: 'red stone of which the blood has not ceased', used with others for a woman who has eaten noxious herbs (in order to produce abortion?) (*šammē^{sun} zirute*), her uterus being overcharged with fluid (*KAR.* 194, iv, 40). This is obviously the haematitis of Pliny (*NH.* xxxvi, 25) which exudes a liquid like blood, and is here used in sympathetic magic. This exudation may perhaps be the *hišbu ša ašāndi* (i.e. *BULUG.GA*) 'fullness, richness of the red stone' (*Br.* 2770: Langdon, *RA.* 1916, 186, 37), which occurs as a drug (*hi-šib ašāndi*) for *huš libbi* (*KAR.* 186, 11). Certainly *ašāndu* can hardly be identified with carnelian here.

We have thus, therefore, to accept that *ašāndu*, in the hands of a seal-cutter, represents some such hard stone as carnelian, while if it is to be powdered for medical use it may equally well express some form of red oxide. This peculiarity is equally apparent in the double meaning of *aḫnū*, which is both lapis (in the seal-cutter's hands), perhaps turquoise, and even a copper carbonate for collyrium (see No. 15 (a)). Both, indeed, may at times be paint.²

Sāndu occurs twice in the Glass-texts (Appendix i, Sect. H), in *aḫnū merku* (moulded blue glass) and as *sāndi ḫalitu* 'roasted *sāndu*' in Sect. F in blue glass. Here the proportions are lost or not given, but they appear to be trivial, and it is not easy to say whether the 'roasted red' refers to an iron oxide, or even litharge.

The other forms of *aGUG* are:

14 (b) [*aGUG ug*]-*gūn-nu* = *pi-li-t[ú?]* (restored from *KAVI.* 185, iv, 8, which includes '*ug-gūn-nu*', and *KAR.* 213, 1, 2, where *uggunnu* is one of seven for 'the good will of Anu', and *ib.* 4, 13, one of seven for 'joy', the red colour being indicative of happiness and good fortune generally). Meaning unknown.

14 (c) *aŠurranitum*, *aGUG.KA*: *šurru*, *šurtu*, *aGIR.KA.GAL* (flint). *Šurtu* was rightly identified by Harper (*BA.* 1894, 435) with silex, flint. Its Sumerian *GIR.KA.GAL* suggests an edge or weapon,

¹ We can hardly suspect *ašāndu* of being cinnabar here. Cinnabar (in *IM.KAL.GUG*, mercury) would appear to be *GUG* simply without the determinative (No. 2 (j)).

² Shamshi-Adad I speaks of 'silver, gold, *aḫnūm*, *ašāmtim*' (*IAK.* 22, 21).

while *AM.* 12, 1, 5 gives apparently the means of producing fire, i.e. flint and steel, . . . -*ni kima nabli lam ikšudu-kinaši šurru u naglabu* . . . 'like flame, before the flint and steel have obtained you'.¹ It, like *aban išati*, is connected with Shamash, the Sun-god (p. 88), *e šurru ša ilu Šamaš* . . . 'O, flint which Shamash' . . . (Geller, *AOTU*, i, 4, 308), the relation of both fire-producing stones with the sun being obvious. The root is probably either the Assyrian *šardru* 'to light up, shine', or the Arab. *ṣarr* 'to be sharp': the Heb. *šorr* 'flint(-knife)' seems conclusive that *šurru* is 'flint', and not pyrites. Since *GIR* = a point or dagger, and *KA* = *pû*, which may be compared to the Heb. *peh* 'edge', we might see in *aGIR.KA.GAL* the literal meaning 'knife with the great edge'.

aŠurranitu, *aGUG.KA*, the *-anu* form from *šurru*, is not easy to settle. The Sumerian would suggest 'red with iron oxide', unless the *KA* represents *pû* 'mouth', 'edge'. It occurs in one doubtful passage in *MT.*, where it is glossed *aGUG aka-pa-sa*, as if the scribe were conscious of a mistake in the text: it is to be pounded and drunk alone in *kurunnu*-beer for some trouble in menstruation (*KAR.* 194, i, 40). Flint would, of course, be out of the question. In *KAR.* 213, iv, 10, it is one of nine used to obtain a position in the palace.

The gun-flints which came from Diarbekr (see note) were of a reddish colour. Are we, then, see 'red edge (knife)' in *šurranitu*? Uncertain.

14 (d) *aGUG.marḥallum*. See *a-marḥallum* (No. 77).

14 (e) (1) *aGUG.Meluḥḥa*, the red stone from Meluḥḥa. (2) *GUG.GI.RIN.NA* 'red stone+calyx'.

(1) Actually, as has already been mentioned, *ašându* was said to have come from Meluḥḥa (ii *R.* 51, i-ii, 17), as also was *aGUG.GI.RIN.E* (Gudea, *ISA.* 157, 22), Meluḥḥa generally being taken to be in Arabia. (For occurrences see *CT.* vi, 11, 1 b, and v *R.* 30, 68, g.). *aGUG.Meluḥḥa* is prescribed to be worn on the neck with others (*AM.* 4, 6, 7), and in *KAR.* 213, iv, 17, it is one of the minerals bringing good luck and plenty. One is mentioned in a 'jeweller's (?) list', *K.* 1278, r. 4, and also in *S.* 914, 10 (v *R.* 30, 5).

¹ If *šurtu* is the flint, and *naglabu* the 'steel', what is *kuṣpû* in the presumed class of temple-servants, *naš naglabi kuṣpê u šurti* (Harper, *BA.* 1894, 428, 430, 435)? There is, it is true, a tool or weapon, used in putting out eyes (*BAG.* 245: v *R.* 56, 54) but there is also *kuṣpû* a box (Syr. *kôph'thâ*, *sacculus, marsupium*), in which it is tempting to see the equivalent of our tinder-box, the little pouch in which the modern Arab carries flint, steel and tinder. Part of the tribute imposed on Ursâ by Sargon (*Ann.* 136) was *šurti naglabi kuṣû*, and as he lived in the north whence came iron and flint (I have myself bought gun-flints in Mosul from Diarbekr), it is possible that he was compelled to send this most useful, if unpretentious, form of tribute. (For flint and steel among the Arabs, see Loftus, *Chaldea*, 213.)

I have bought a quantity of diminutive carnelian arrowheads and other shapes (all pierced for wearing) in Suakim, where I was told that they came from Mecca. It is not unreasonable to identify this special red stone, described as having come from MeluhĤĤa, with the carnelian, which we have already accepted as one meaning for simple “GUG, particularly as the old tradition of wearing it still survives.

(2) “GUG.GI.RIN.NA (v. E), nodules of haematite from the Persian Gulf (the Island of Hormuz (?)).

As is shown above in (1), Gudea mentions “GUG.GI.RIN.E as coming from MeluhĤĤa, and this is doubtless the same word as GUG.GI.RIN.NA = *Dil-[mun-ni-tu?]* (v R. 41, 20, g; cf. LT. I, viii, 17). GI.RIN.NA = ‘calyx’, esp. the large calices on the backs of couchant stone animal figures, and in “GI.RIM.ŠĀR.GUB.BA it means the nodules or spheres of iron pyrites (No. 9 (c)). The area defined by Dilmun is uncertain (see AAA. xx, 99), but it is in or round the Persian Gulf, and probably includes the islands. ‘Red earth’ or ‘Indian Red’ is mentioned by Royle (*Ant. Hindu Med.*, 97) as coming from the islands of the Persian Gulf, and the island of Hormuz, one of the larger, has always been noted for its export of red ochre, in which nodules of a very pure haematite occur (EB. 11th ed. xiii, 695), and it may be these latter which are intended. “GUG.GI.RIN.NA is included along with “GUG in K. 8785, 14.

14 (f) “GUG.Marĥaši (read sându Marĥaši), see No. 9 (e) (1).

14 (g) “GUG.Gutium (Ķutī), sându Ķutī, sandyx, cinnabar (?).

‘The Red Mineral of Gutium’, a district in the Persian Mountains on the E. Assyrian frontier, which admirably coincides with the position of the cinnabar of Takht-i-Sulaiman (G. 69, 70). Since we are fairly sure that “GUG.MeluhĤĤa is carnelian, and that “sându Marĥašitu is the sandrisitae, the aventurine of Pliny (No. 9 (e) (1)), both being minerals of definite character, we may, I think, see a third of equally definite character in “sându Ķutī which comes from the neighbourhood of Kerkuk Baba, and will therefore be cinnabar (from which mercury is obtained), and we might see in “sându Ķutī the origin of the Greek sandyx by a ‘merchants’ garbling’. If so, it is a longer form for cinnabar than the simple GUG, which has probably the same meaning, in IM.KAL.GUG, mercury (as I suppose it to be) (No. 2 (j)).

14 (h) “AN.GUG.ME, uncertain.

It has the same peculiarity as iron ochre (8 (b)), exuding a red colour: cf. Strong, BA. ii, 1894, 635, 636: TL. 63, 10 ff., 64, 24: *karanē ištu libbi* “AN.GUG.ME *ana kaḫḫiri itabbuku* “AN.GUG.ME *ina eli kaḫḫadi ‘amari ša irši imarruku* ‘the wine from the middle of the

AN.GUG.ME-stone they shall pour away on the ground: the *AN.GUG.ME*-stone (itself) they shall rub on the head of the *amaru* of the bed'. Senn. took great slabs (?) of it from Hezekiah (Luck., *Senn.* 34, 41-3) 30 *bilat huraši* 800 *bilat kaspi nisikti guhli daggassi* **AN.GUG.ME rabūti*^{pl}. A dagger has its hilt adorned with lapis set in gold, with the knob of *AN.GUG.ME*-stone retained in some way in gold (*TA.* No. 22, ii, 16, from Tushratta): nine neck-bands (?) (of gold (and) *AN.GUG.ME*-stone, (*ib.* No. 14, ii, 2, from Amenophis IV). **AN.GUG.ME* occurs *Gilg.* ix, vi, 28: it can be threaded in magic (*BBR.* 11, r. 7 &c.). I am in doubt if *SLT.* 76, i, 4, 5 can be referred here.

Not easy to identify if the above descriptions refer to the same stone: it has the peculiarity of iron ochre, and yet can be used in dagger hilts in contrast to the blue of lapis, and it is so valuable as to be singled out by name in a short but very costly tribute list from Palestine. A greenish-red marble is found near Jerusalem, and also a white marble with rosy-tinted markings, which occurs soft, and can be easily cut, after which it hardens: chrome is also found in quantity at Antioch, Alexandretta and the Amanus (*Adm. Hdbk., Syria*, 96, 288).

14 (i) *Kubbutu? (*GUG(?) . . . GI.RIN.DA), hepatic cinnabar(?).

Philologically **kubbutu*, if correctly read, might be referred to the same root as *kabattu* 'liver', and so compared with hepatic cinnabar or 'liver ore'. Cf. Syr. *kabhdânâ*, *hepatitis* (terra). This is so uncertain as to be of no value.

14 (j) *Kasî.ŠAR, *kasî, *SILA.ŠAR, 'rose stone', the same as *GUG.SILA.ŠAR 'rose-red stone'.

See No. 61 (b).

14 (k) *GUG.DIR, a reddish-brown stone.

With others hang on neck for attack of ghost, *AM.* 88, 4, r. 8, dup. *KAR.* 184, 13. **DIR* simply, described as *ša kima bulali* 'which is like opium' (*AH.* 46) to anoint eyes (*AM.* 16, 3, 9), certainly suggests a reddish brown, the colour of the opium.

To sum up: like the Blue Stones (No. 15 (a-b-c)) there seems to be some overlapping. Simple *GUG* may perhaps be cinnabar (perhaps **sându Kutî*, also): **GUG* appears to mean carnelian for beads, jasper for larger pieces, but even an ochre (cf. **KA, IM.MAL.LI.GUG*, and perhaps **AN.GUG.ME*, which would all appear to have similar claims to ochre): there is the special ochre of the Persian Gulf known as **GUG.GI.RIN.NA*. **Sându Marhašitu* was taken over by Pliny in the form sandrisitae, aventurine: the 'rose-red stone', **GUG.SILA.ŠAR* goes far to prove my identification of *kasî.ŠAR* with the rose.

15. THE BLUE STONES

- (a) *Uknû*, *ZA.GÌN*, lapis lazuli, turquoise, ultramarine, azurite (carbonate of copper) (perhaps *ZA.GÌN.KUR* also used for this latter).
 (b) *Šipru*, *ZA.GÌN.AŠ*, *ZA.GÌN.AŠ.AŠ*, 'hard blue stone' and 'hardest blue stone', sapphire (but sometimes used for a less hard blue stone).
 (c) *Abnê birûti*, turquoise.

15 (a) *Uknû* was long ago identified as lapis lazuli (Pinches in S. A. Smith, *Keils. Asurb.* iii, 97 (1889): Hilprecht, *ZA.* viii, 1893, 185), it being used to describe two small disks of the Kassite period (*ib.* 192). Jensen, probably rightly, saw in the name the same word as the cyanus of Pliny (quoted Brockelmann, *Lex. Syr.*, the Syr. *kûnâ'â* or *kûnâ'â*). Hyacinthus may, I imagine, have the same origin, and indeed, if the *ZA* of *ZA.GÌN* is to be read *IA₄* (= 'stone'), we should have the original word *IA₄.GÌN* as the origin of *uknû*, cyanus, and hyacinthus.

Uknû is the blue stone in the list of materials for Assyrian seals (*ib.* 8 (b)-(f)) (cf. also 1 *KIŠIB ZA.GÌN*, Barton, *UMBS.*, ix, 1, p. 20, 1, 4, and also an early letter, Ebeling, *RA.* 1913, 30). This will coincide with the lapis seals which occur from the earliest period (*SC.* 7). Lapis¹ was used in very early Sumerian times, since it forms part of the beautiful 'standard' found by Woolley at Ur (*Aj.* viii, 1928, pl. lix: *HMU.* 29), and it was evidently a material much prized abroad, for merchants carried it (although rarely) to Egypt as early as Badarian times (*MAE.* 73: cf. *AEM.* 166). Beck's list of Mesopotamian bead-materials shows that it was used very commonly at various times for beads.

ZA.GÌN means literally 'mountain-stone' (accepting *ZA* (as *IA₄*) = *abnu* 'stone'). In this case I would suggest that the 'mountain' does not refer to the provenance of the stone (which would apply to most of the Assyrian stones), but to the idea 'blue' as represented by the blue of the distant Persian mountains as seen from the flats of Mesopotamia. What I noticed particularly as I came up the Tigris during the War, was the gradual appearance of the hazy, bluish mountains in the distance as seen from above Amarah. Its popularity for making objects is shown by the long list of articles made (or possibly coloured) with it, and the numerous words for its different shades. Cf. Scheil, *RA.* 1918, 116, r. 51 ff. (*TU.* No. 36): Pinches, *CT.* vi, 11 ff.: *CT.* xviii, 19, K. 4377, 12-15. The kinds herein given are: *ZA.GÌN.A* (i.e. *DUR₅*)² = *uknû*, *zagindurû*,³ *uknû ellu*, *uknû ibbi*, *uknû namri* (the latter three 'clear' or 'bright' lapis): [*ZA.GÌN.GÛ.TU* (= *ŠU-u* (i.e. *zagingutû*)) (= *ša*

¹ On lapis in general see Holdich, *Gates of India*, 426, 507.

² Cf. *ZA.GÌN.DU.UR* = *ZA.GÌN.DUR₅* = „*za-ku-ur-a-a-ku*, 'L' 90.

³ Read for the seven stones in *KAR.* 213, 4, 19, *dušû*, *sându*, *uknû*, *ZA.GÌN.DUR₅*, *IGI.MUŠ*, *hulahu*, *šubû*.

kišadu asummatum, the grey on the neck of the dove or pigeon: *ZA. GÌN.UGA.ĤU = *ša kišad aribi*, the dark sheen of the raven's neck: *ZA. GÌN.LU.ŪB = *laptanû*, the colour of the *laptu*-vegetable: *ZA. GÌN.GEŠTIN = *karanum*, the Homeric 'wine-coloured': *ZA. GÌN.ANŠU.EDIN.NA = *purimanu*, the colour of the wild ass: *ZA. GÌN.MUL.MUL = *kakka[banu]* 'starry':¹ *ZA. GÌN.BUR.UM.UT.TUM = *burumitum*, variegated. There is also ŠĪG.ZA. GÌN.DIR = **argamanu*, red-purple, of wool (Br. 11780), ŠĪG.ZA. GÌN.ĠĠG = **takiltu*, dark blue, of wool (Br. 11783):² and ŠE.ZA. GÌN.DUR₅ (*še-im ĥu-[un-nu-bu]*, a colour of corn (perished (?), Arab. *ḥanaba*(?) D. 367, 238). But **uknû* means more than merely lapis (so Haupt, *AŷPhil.* 1924, 245), probably including turquoise. For this consider the provenance of the two stones:

(a) Lapis, from Badakshan in the Kokcha valley, between the Hindu Kush and the Oxus, E. of the Caspian. This coincides with the cuneiform description (Darius-period) which says that **uknû* came from Sugdu, Sogdiana (Scheil, *MMAP.* xxi, 8, 26).³ In these mines the rock is split by fire to obtain the three kinds of lapis (*nili*, indigo-blue; *asmani*, sky-blue; and *sabzi*, greenish, *EB.* 11th ed., xvi, 199-200).

(b) Turquoise, according to Mohammed ben Mansur (quoted *PSG.* 130) from Nishapur (the best) and others from Ghasna, Irak, and Kerman. There are seven kinds of the first, that named after Abu-Ishak being the best, and the Andelibi, of a milky hue, the weakest, a fourth, Sermuni, having gold spots. Esarhaddon obtained **uknû* from Mt. Bikni in Persia (*PE.* iv, 47: Lenormant, *PSBA.* vi, 342), and in ii R. 51, iii-iv, 13, it came from the mountain of *AN.GUD* (glossed *Dapara*). The latter Lenormant ingeniously compared with the Tapures of Ptol. vi, 2, 6, the Tapyres of Pliny *NH.* vi, 16, or Tapyrrhes of Steph. Byz., s.v., i.e. Tabaristan, S. of the Caspian, associated with the Abakaina of Ptol. vi, 2, 17, which must be Bikni. These coincide with the actual turquoise mines at Madan, on Mt. 'Ali Mirsai, near Nishapur (see *EB.* 11th ed., xxvii, 483).

There is another locality, the Sinaitic Peninsula, whence turquoise comes (see 15 (c)).

**Uknû*, therefore, was found in two localities, one noted for lapis, the other for turquoise.

This confusion between the various blue stones existed elsewhere in ancient times, e.g. Pliny (*NH.* xxxvii, 37) speaks of a Cyanus (Scythian, Cyprian, and Egyptian), both male and female, sometimes with gold-

¹ Cf. the phrasing in *WM.*, 209, on lapis: 'the deep-blue ground set with bright, brassy specks of iron-pyrites suggests a comparison with the blue sky bedecked with stars'. This Scheil recognizes.

² Also, as *ZA.GÌN.DUR₅, a reddish glaze. See further.

³ The Hittite texts give the provenance as Dagniara, unknown (*KTB.* iv, 1: *KUB.* ii, 2: *KS.* iv, 80, 36).

dust seen within it, 'in much the same way as the Sapphirus': Theophrastus, however, speaks of Cyanus as if it were a mineral used merely as a paint, either an inferior lapis, or rather a lazulite prepared for painter's use, or it may have been sulphate of copper (so King, *PSG.* 187). Since he says that the Sapphirus was 'spotted as it were with gold' (xlirii) King (*PSG.* 293) considers that this was our lapis also. There is, therefore, no objection to our seeing both 'lapis' and 'turquoise' as equivalents for ʾuknū.

Whether the Assyrians used actual lapis (as is the custom of the modern Orientals) as ultramarine paint is uncertain, but that they did powder blue stones for paint is certain from the existence of a special pestle for ʾuknū, i.e. 'C' 31, ʾNA.ZA.GĪN.NA = ŠU-ku = duktu (cf. ʾZA.GĪN.NA.ZAG.LAL = pu-us-su-[su(?)]), 'pounded (?)'. More probably it was the blue of carbonate of copper, (see Laurie, *Materials of the Painter's Craft*, 42, 230), or azurite, which Lucas says (*AEMI.* 283) was the earliest blue pigment in Egypt. Tavernier (quoted *PSG.* 187) noticed a cheap substitute (Lapis Armenius) for ultramarine used in Persia. Indeed, Lucas denies the existence in Egypt of the use of lapis thus powdered as a paint, saying (*ib.* 286) that there is no proof that ultramarine was known before the eleventh century A.D. A blue paint, however, seems intended in the Assyrian inscriptions and, apart from the constant use in historical texts, we find a bed of ʾuknū (Langdon, *UMBS.* x, 2, 135, 32), i.e. probably painted (or otherwise decorated) with blue. In an eye-text in *MT.* (*AM.* 10, 1, iii, 1 and 20) vessels are described as dalli-[šī]na ʾḫulali karpāti¹ -šīna ʾuknū ibbu 'their dallu-vessels¹ of white(-lead), their goblets of translucent (or, unspotted with mica) blue (lapis)'. Still further can we trace this ʾuknū *ḪAR* (= tēnu) 'ground lapis', in one recension of the Descent of Ishtar (v *R.* 31, r. 56: *CT.* xv, 47, 35), the pipe for Tammuz being apparently malil ʾuknū (*ḪAR*)² ʾsāmti, i.e. of blue (ground up) and red, not necessarily made actually of the material, but of bone or reed dyed blue and red. Similarly the pen of Nin-geštin-anna, the female scribe of the gods, is of ʾuknū and ʾsāndu (*CT.* xxiii, 16, 15). Thureau-Dangin's excavations at Til-Barsip show that the Assyrians of the ninth century used a form of copper for blue paint (M. Granger's analysis, *RA.* 1933, 150): *Silice*, 74, 27: *Oxyde de cuivre*, 10, 37: *Alumine*, 2, 98: *Oxyde de fer*, 0, 50: *Oxyde de manganèse*, 0, 17: *Chaux*, 9, 19: *Magnésie*, 0, 84: *Potasse*, 0, 85: *Soude*, 0, 29. But there is a blue substance defined by the simple ʾuknū of *MT.*, indicating a soft, friable drug used for ears and eyes, which must also be a copper: for ears, *AM.* 33, 1, 26: eyes, *AM.* 12, 4, 4: some skin-trouble called lamṣat ḫilāti, apply, *AM.* 44, 1, ii, 6, where

¹ See *PRSM.* 1924, 30, for the equivalence of the dallu with the mod. Mesopotamian delleh (coffee-pot).

² *ḪAR*, tēnu, 'ground up', omitted in one text.

it is perhaps 'female' *uḳnū* (text uncertain), with which cf. Pliny *NH.* xxxvii, 38, of cyanus male and female, and *IB.* 1713 (in a note by Leclerc), male and female turquoise (mentioned by Temimy). Stapleton (*MASB.* 351) quotes the 'Stone Book' (107) as saying that if *lāzaward* be dropped on heated charcoal a tongue of fire of the colour of *lāzaward* will come out, which, as he says, indicates copper (probably azurite, copper carbonate), and he says that the Arabs also seem to have believed that *lāzaward* contained copper. In *BMM.* 23 *lajavarda*¹ is a silicate of copper with iron and lime, and it is used in India as a collyrium (which may be the same as the *dehlij* of No. 19 (a)). We may, therefore, see in *uḳnū* a third value, that of carbonate or other form of copper, used both in eye-prescriptions and paint.

Still further, a longer form, **ZA.GÌN.KUR.(RA)*, 'mountain lapis', is used in *MT.*, alone in *himetu-ghēe* to anoint eyes (*AM.* 12, 3, 4+16, 3, 10), so that it must be similar to the carbonate of copper prescribed above. It is used commonly in *TA* (see p. 139), for a seal in Ashur-uballit's time (*TA.* 16, 11), and it is mentioned in Agum's text (v *R.* 33, ii, 36). *TUK.ZA.GÌN.KUR.RA* (*Camb.* 66: *Nbn.* 794), represents blue wool. This can, therefore, represent a drug, a hard blue stone for jewellery, and a colour (perhaps even the dye) for blue wool.

ŠE.ZA.GÌN.DUR₅ as *še-im hu[nnubū]*, apparently the colour of blighted corn, presumably a green, is paralleled by **ZA.GÌN.DUR₅*, a simple glaze of sand and alkali (with the addition of a gum to make it adhere?) (Appendix i, B), probably with a greenish tinge: 'the materials employed in glass-making always contain a small quantity of oxide of iron, which imparts a greenish tint to it if in the state of protoxide, or faintly yellowish if peroxide' (*EC.* 680). This greenish tinge suggests that a comparison was made with the colour of blighted corn, apart from the fact that there are more elaborate directions given for making *dušū* 'crystal', i.e. a specially clear glass. Again, **ZA.GÌN*, simple *uḳnū*, either with or without the epithet *merku*, is always made with *tersitu*, a compound with copper (Appendix I, Sects. F-L), indicating that simple *uḳnū* (as distinct from **ZA.GÌN.DUR₅*), was a blue: **ZA.GÌN.DIR*, a red-purple glaze is also made with *tersitu*, but in this case the receipt is immediately followed by instructions for making the red copper sub-oxide, which indicates that the *tersitu* in this case was a copper compound which would give a red tinge, and not the blue of the black oxide. **ZA.GÌN.DUR₅* (particularly equated with *ibbu*, *ellu*, and *namru* 'clear'), has thus very little of the blue of *uḳnū* in it, and was probably a simple glaze. In *MT.*, use uncertain, *AM.* 69, 12, 4.²

¹ Called lapis, but lapis contains no copper, which is probably why this lapis is not mentioned as a drug in *SM*.

² Two other forms may be mentioned, of uncertain meaning: *ZA.GÌN.GAL* and *ZA.GÌN.KIR.RA* (*RTC.* 204, 2, 3, quoted Boson, *Fr.* 19).

15 (b) ^aŠipru, ^aZA. GÌN. AŠ, ^aZA. GÌN. AŠ. AŠ, sapphire.

I have already tried to show in *OTC.* 97 that the terminations *AŠ* and *AŠ. AŠ* added to a stone indicate the relative increase of hardness, and have included the evidence again under the two other groups ^aPAR. AŠ and ^aPAR. AŠ. AŠ (No. 17 (b)); and consequently the groups ^aZA. GÌN. AŠ and ^aZA. GÌN. AŠ. AŠ, (both equivalent to *šipru*, *CT.* xii, 40, iii-iv, 12-13) mean 'the hard lapis' and 'the very hard lapis'. In addition to these, also equivalent to *šipru*, are ^aZA. GÌN. GŪ 'neck-lapis', ^aZA. GÌN. ZUN, ^aZA. GÌN. SIG₅, and ^aZA. GÌN. SIG₅. GA (*CT.* xii, 40, iii-iv, 11 ff.: *Br.* 11777-9, 11781, 11787: *TU.* vi, 36, r. 9-11), while ^aZA. GÌN. ZUN. GUSKIN and ^aE. GŪ. ZAG. GÁ both = *šipir ħuraši* (*CT.* ib. 17: *Br.* 11782: *MA.* 860: *HWB.* 559: Scheil, *RA.* 1918, 117, 63: *TU.* ib. r. 12).¹

Obviously, from its connexion with *aknû*, 'lapis' (hardness 5.5-6.0) or 'turquoise' (hardness 6.0) we have to see in ^ašipru some special kind of blue stone, and one harder than these two. Philologically the first stone which suggests itself for *šipru* is the blue sapphire, the Arab. *šafīr*, identical in its consonants with *šipru* (hardness 9.0). The well-known test of hardness of a stone is, of course, its power of scratching another, and it is in this 'scratching' that we must seek the origin of the meaning 'sapphire', *šipru*. It is from the same root as *šupru* 'finger-nail' (*šapâru* 'to scratch'), and the same word *šipru* exists as 'the point of a weapon' (*MA.* 886): Syr. *tephrâ* 'nail, claw', which has also the meaning onyx²; and cf. the very indicative parallel *šippôrên šâmîr* (*Jer.* xvii, 1) 'point of *šâmîr* stone' the *šâmîr* being certainly 'emery' *σμυρίς*³, (^aAŠ. MUR, see No. 4 (u)) i.e. a form of corundum, used for cutting seals. Note particularly the equivalence ^aZA. GÌN. [AŠ] = ^ašipru = ^aku-nu-[ku], lit. 'seal-stone', i.e. one that is used for making seals.⁴

The longer form, 'the hardest blue stone', ^aZA. GÌN. AŠ. AŠ, occurs only in syllabaries (ii *R.* 20, 13, my *CT.* xii, 40 ii, 13) and not on the early text *CT.* vi, 11, 22 although ^aZA. GÌN. AŠ, the 'moderately hard', does. The inference is that the very hardest may not have entered Assyria at a very early date, but this is not certain, and, in point of fact, although we have undoubtedly to accept *šipru* as corundum, the hardest stone the Assyrians had, we have also to consider a softer form described as 'golden *šipru*' which shows that we have here a form of lapis.

¹ Note *TU.* ib. 7-8, ^aZA. GÌN. GİŠ. AŠ = ŠU-u, and *šip-ri*, but Scheil, *RA.* 1918, 116-17, 58-9 (the same text), ^aZA. GÌN. šab-rum.

² Lenormant, *TSBA.* vi, 339, while translating *šipru* 'marble', compared Aram. *ṭ-ph-r* 'albâtre, marbre, étroitement apparenté à *ṭ-ph-r* 'ongle'.

³ Gesenius (*v. Smith DB.* i, 21), followed by Petrie (*Hastings, DB.* iv, 621).

⁴ 'H' 24, 25. The restoration of *kumu[ku?]* was suggested by *MA.* 860.

Although sapphires may show flaws, this, which is obviously the gold speckling of lapis, is not a sapphire. This spangling of lapis with iron pyrites is indicated by Pliny who describes two kinds under cyanos saying that the sapphirus has spots like gold (*NH.* xxxvii, 38, 39). Although, therefore, *aZA.GÌN.AŠ.AŠ* (*šipru*) 'the very hard blue stone' must be reckoned as our sapphire, it must be admitted that 'golden sapphire' cannot be included among the corundums. As has already been mentioned (No. 15 (a)) the Greek *sappheiros* is accepted as some form of lapis, and not as our sapphire, which is properly hyacinthus.

This softer *šipru* must have formed the beads of Ishtar's necklace (on the Deluge Tablet, *GE.* xi, 164), described as *aZA.GÌN.GŪ*, a form of *šipru*. It is obvious that, if the Assyrians had no harder stone than corundum, the beads, which would have to be drilled, must be of a softer substance, and actually the 'blue stone of the neck' (*aZA.GÌN.GŪ*) does not in itself indicate any definite stone. If the editor had wished, he could easily have been clearer by saying *aZA.GÌN.AŠ*.

Moreover, in considering the relative hardness of these blue stones, the *algamišu*, definitely the stone used as a drill (No. 30), and the *AŠ.MUR* 'emery' (see No. 4 (v)) must not be forgotten. Actually sapphires, I believe, have not been found in Babylonian excavations: their actual provenance is Kashmir or Ceylon (*EB.* 14th ed., xix, s.v.).

To sum up: *aZA.GÌN*, the softest blue stone, represents lapis, turquoise, ultramarine, azurite, carbonate of copper in the *MT.*, and blue glaze: *aZA.GÌN.AŠ.AŠ*, *šipru*, the very hard blue stone, the scratching stone, sapphire, corundum: and *aZA.GÌN.AŠ* a blue stone of intermediate hardness.

15 (c) Abnê birûti, turquoise (?).

It occurs only in the tribute to Esarhaddon from Iata', the son of Hazael of Adumatu (Edom): 'ten manas of gold, a thousand *birûti* stones, fifty camels, (and) a hundred *kunzi* (bags?) of gums' (*PE.* 20, 20). I suggest that (a) the turquoise mines of Sinai are not far distant from Edom: (b) the Arab. is *fîrûz*, the Persian *pîrôzah*, and the Syr. *pîrûzg*: and (c) the numbering of the small nodules (1,000) suggests turquoises: are definite evidence that *birûti* are turquoises. For an interchange of *t* and *z*, cf. Tyros, Šôr: Skuthoi, Ašguzai: Pelethi, presumed Philistia. Presumably Esarhaddon here adopts the local name for turquoise, rather than using his more usual *aZA.GÌN*.

16. CERUSE, WHITE LEAD, AND RED LEAD

16 (a) *Ḫulalu*, ^aZA.ṬU (*ni-ir*), ceruse, white lead: *sāsu*, ^aZA.ṬU.BE, red lead.

16 (b) ^aZA.ṬU, as a determinative indicating effervescence in certain carbonates, (their action under acid).

16 (a) In discussing this very difficult word we have to consider (a) ^aZA.ṬU as a mineral by itself; (b) ^aZA.ṬU as a prefix to other minerals. That these two distinctions are clear is apparent from the groups ^aZA.ṬU, and ^aZA.ṬU *ini* on the one hand, and, on the other, a limited number of such groups as ^aZA.ṬU.PAR.AŠ and ^aZA.ṬU.PAR.AŠ.AŠ, as separate from ^aPAR.AŠ and ^aPAR.AŠ.AŠ. Note that although the Sumerian may give, e.g. ^aZA.ṬU.MUŠ.GIR, the Assyrian translation ignores the ZA.ṬU and translates simply *šir-gar-ru* (CT. xvii, 39, 48).

In OTC. 88 ff. I tried to show that ^aZA.ṬU by itself meant 'white lead', 'carbonate of lead', i.e. ceruse either as a mineral, or as an artificial product, and that this, when used as a determinative to other stones, by a transference of the idea of obtaining ceruse by means of vinegar (shown in the word *ḫulalu*, probably meaning 'the acetated'), was applied by lapidaries to those carbonate, sedimentary rocks, for which the easy and elementary means of identification (as at the present day), was the application of an acid, which would produce an effervescence. *Ḫulalu*, as a translation of ^aZA.ṬU, is curious as a word, since it has no obvious relation with any stone, and yet it is paralleled (so far as 'acetated' goes) by ^aZA.SUḪ, *šupû* or *šubû*, either the Syr. *š'phâ*, in pael, *liquavit*, indicating the result of exposing pyrites to the air to obtain vitriol, or, more probably, the Syr. *šaiûbâ*, *putridus*, with the same idea (see No. 9 (d), (1)).

'B' 16, 'K' 6 ff., 'L' 95, and CT. vi, 11, 44 ff. show the following ways in which ZA.ṬU occurs: simply, as ^aZA.ṬU: ^aZA.ṬU.BE: ^aZA.ṬU.IGI: ^aZA.ṬU.PA.ḪU.NA: ^aZA.ṬU *elallum* (*alallum*): ^aZA.ṬU *mada(l)lum*: ^aZA.ṬU.MUŠ.GIR: ^aZA.ṬU.IGI.MUŠ.GIR: ^aZA.ṬU.PAR.AŠ: ^aZA.ṬU.PAR.AŠ.AŠ: ^aZA.ṬU.ID.ZA.SUḪ: ^aZA.ṬU.TAB: and ^aKIŠIB.ZA.ṬU, ^aPA (or KIL). ZA.ṬU: and ^aBIR.ZA.ṬU.

Two other forms have the value *ḫulalu*, i.e. ^aZA.SU and ^aZA.NIM.¹ I do not know of any actual instance of ^aZA.SU used in a text, but ZA.NIM is used in Gudea (ISA. 111) and '17 ^aZA.NIM'

¹ ^aZA.MIR.IGI 'ZA.MIR of the eye' must represent some form, probably by mistake (Scheil, RA. 1920, 212, 213, Gudea period), especially for women: '2 ^aZA.MIR.IGI for the woman Amat-Ninlil': '1 ^aZA.MIR.IGI for Datin-Ninni'.

(TE. No. 6055, r. iii, 8); '3 ZA.NIM.IGI' (*ib.* 6044, v, 6); '9 ZA.NIM', (RTC. 203, 7 (all middle of Third Millen.)). Cf. '2 ZA.NIM IT.TÁR' (TE. 6044, r. v, 17) and a seal of ZA.NIM . . . , *ib.* iv, 4. But, although ZA.NIM and such are found equivalent to *hulalu*, they are not used to replace ZA.ṬU as prefix to a group like *PAR.AŠ*, &c.

The form *hulalu* can be compared to *dumamu* 'lamentation', *hurašu* 'gold' (something dug, or from the cognate 'to be yellow'), *lubašu* 'something worn', *šukanu* 'property' (something deposited), *dumaḫu* 'gift'. *Hulalu* will then mean 'something acetated', if we accept a possible verb *halálu*, cognate with the Syr. *hallā* and Arab. *hall* 'vinegar' which has a late Bab. equivalent *halla* 'vinegar' (Meissner, *AṣSL*. 1931, No. 3, 190, occurring in '1 šappatu *halla*', *Dar.*, 91, 4, and cf. Dougherty, *YOS.* vi, 58, 3, 'karan *halla*). *Hulalu* has the same form as the Syr. *hūlālā*, *purgamentum*, *sordities* with which cf. Theophrastus' remark about a 'kind of foulness' as indicating the lead scraped off in making ceruse. At the same time of course, this comes from the Syr. *hallel*, *purgavit*, so that there can hardly be a connexion (except by mistake), between the Syr. *hūlālā* and *hall*, vinegar. It is, however, a coincidence that the Sumerian *BIL.LAL* (= *enšu*, *ṭābatu*, 'vinegar'), also means *lu'u* 'foul'.¹ In seeking the origin of the word *hulalu*, it is conceivable that it originated with the lead miners themselves, such as lived to the north west, far out of the range of the Assyrian dialect proper, and that their dialect approximated (if it was Semitic) to those divisions of Semites who used *halla* at an early time for vinegar.

White lead, the ancient cerussa, is prepared by the action of acetic acid on metallic lead. According to Theophrastus (ci) 'Lead is placed in earthen vessels over sharp vinegar, and after it has acquired some thickness of a kind of rust, which it commonly does in about ten days, they open the vessels and scrape it off, as it were in a kind of foulness; they then place the lead over the vinegar again, repeating over and over again the same method of scraping it, till it is wholly dissolved; what has been scraped off they then beat to powder, and boil for a long time; and what at last subsides to the bottom of the vessel is the ceruse. (cii) In a manner also, something resembling this is verdigrise made; for copper is placed over the lees of wine and the rust which it acquires by this means is taken off for use.' Pliny (*NH.* xxxiv, 54) says that 'psymithium, known also as ceruse, is made from very fine shavings of lead placed over a vessel filled with the strongest vinegar, by which means the shavings become dissolved, or it may be made by putting lead into jars filled with vinegar, which are kept closed for ten days, and then the sort of mould which forms upon the surface is scraped off, and the lead is again put into vinegar, until the whole metal is consumed.'

¹ D. (1933) No. 579, 247, in spite of my note, *PRSM.* 1924, 21, still adheres to the old 'mit Wasser gemischter Wein' for *A.GESTIN.NA*, *ṭābatu*.

Next, an important piece of evidence is from 'K' 6, 7, ^aZA. *ṬU* = *ḫulalu*, and ^aZA. *ṬU.BE* = *sāsu*. *BE* in *MT.* constantly means 'roasted' or 'heated' (*PRSM.* 1926, 37: *OTC.* 88, *siḫēru*, *SAI.* 872, Arab. *saḫara* 'scorched, heated').¹ Consequently *sāsu* is 'roasted *ḫulalu*'. *Sāsu* is certainly the Syr. *sāsgūnā*, purpureus, which is literally, when broken up into its two words, *sās* (+ *gūnā* 'colour').² The explanation is simple, if ^aZA. *ṬU*, *ḫulalu*, is 'white lead': red lead, minium, is prepared by heating metallic lead, carbonate (i.e. white lead), and dross in a reverberatory, to form litharge, grinding this between stones, and subjecting again to heat: 'orange mineral' is usually prepared by calcining white lead (*EC.* 756). To go back to classical authors, Diosc. (v, ciii) says that red lead can be prepared from white lead if it is roasted, and Vitruvius states that sandarach is obtained by heating white lead (ceruse), which, as *SEC.* 29 points out, is a mistake for red lead obtained by igniting white lead. Pliny (*l.c.*) says of ceruse that when melted a second time, it becomes red. Democritus (*HS.* ii, 92) directs that ceruse shall be roasted 'until it become the colour of sandarach' (cf. Diosc., *l.c.*).

So far then, we can show reasonable evidence for the form *ḫulalu* 'the acetated thing' as white lead, giving a red lead when heated, a product well known in ancient times.

Next, *ṬU* has a definite relation to weight, which would be natural if *ZA. ṬU* is really a form of lead (i.e. *ṬU* = *šakālu*, to weigh, *šiklu*, shekel, *šimtu*, price, and *šapālu*, be low, i.e. weighed down). Again, white would appear to be the colour of *ZA. ṬU* from Thureau-Dangin, *RA.* 1921, 168: ^aZA. *ṬU* is to be fastened on the right foot of a pregnant woman against the *lamaštu*-demon, with ^a*nibu* (= *ianibu*), that is, the white ^aZA. *ṬU* and black vitriol are together on the one foot, while on the left are bound in contrast ^a*sāmtu* and *uḫnū*, red and blue. (Cf. Senn., p. 138.)

In *MT.* ^aZA. *ṬU* occurs about a dozen times, usually in ritual use as beads, &c., but also for applying to temples (*AM.* 20, 1, 31); and possibly to be applied in oil (*AM.* 41, 2, 6), while in *CT.* xxiii, 41, 1 *ZID. ZID. aSAK. KI ZID. ZID. aḫulali* (powder of *SAK. KI* and of *ḫulalu*) is to be anointed on the temples in oil. *IB.* 73 prescribes white

¹ *Te-siḫ-kir* varies in *MT.* with *BE-ir*, *BE* being *siḫēru ša mē* (*SAI.* 872). *E.* (xiii, 8) showed that the variant *tesikir* might be connected with *siḫrute* 'als etwa gekocht'. Cf. *ina tinuri BE-ir GIBIŠ (DUL.DU)* 'thou shalt roast in an oven, take out' (*AM.* 40, 1, 53: 68, 1, r. 4: 70, 5, 17: 76, 2, 3: 78, 9, 6, dup, 81, 2, 12: 83, 1, 21) and especially [*ēste*] *niš tabašal ina tinuri BE-ir GIBIŠ* 'thou shalt boil together, roast in an oven, take out' (*ib.* 76, 2, 3), and 'wash in water, roast in an oven, . . . wash', *ina tinuri tatar BE-ir* ('in the oven again roast') (*ib.* 42, 1, 5). Cf. *erū BE* 'burnt copper' (as better than 'old copper' (No. 7 (i))).

² ^a*Sāsu* (^aZA. *ṬU.BE*) is of rare occurrence in Assyrian literature, but, curiously enough, it appears with other chemicals in *Gilg.*, ix, vi, 27. It is in the list *CT.* vi, ii, 45 (a) (read thus), and as one of thirty-four against 'anything evil, the Hand of a Bull' (*KAR.* 213, iii. 16).

lead to the forehead as an embrocation: mod. Indian practice (*BMM.* 34) indicates carbonate of lead in powder and ointment on irritated skin or erysipelas (but not to be used if the skin is broken), and in combination with butter as an ointment to the scalp. Other (ritual) uses are: when a man's head smells unpleasantly (?) *AM.* 2, 1, 9, *CT.* xxiii, 37, 9, *PRSM.* 1924, 7, threaded with others: *AM.* 29, 4, r. 6, with others apparently for sore throat or neck: *AM.* 46, 1, ii, 2, threaded: *AM.* 47, 3, iv, 31 and 52, 6, 5, with others on 'middle' (pubes): *AM.* 71, 1, 19, in a long ritual: *AM.* 92, 2, 5, uncertain: *AM.* 102, 21, with many others, on red wool, bound on temples. Note also *ḥulal īni*¹ 'ḥulalu for the eyes' as a special form: *IB.* 73 (quoting Diosc. v, 103) says that the best ceruse, from the first sifting, is used as a remedy for the eyes (cf. *SM.* ii, 86 ff., where ceruse is used frequently for eyes). Pliny (*NH.* xxxiv, 54) says that ceruse was used by females to whiten the complexion, and Layard (*Nin. and its Remains*, ii, 329, 330), quotes Nicolaus of Damascus as saying that Nanarus, a governor of Babylon some time after Sardanapalus, is said to have had his eyes underlined with stibium and his face painted with white lead. *Ḥulal īni* is used apparently in decoration of the breast of the king, e.g., iv *R.* 18*, 3, 2 ff. *abnu rabē^{pl}* (ditto) *abnu elšiš kunzubu* (4) *ana šir ilāni^{pl}* *rabiš šuluku* (6) *ḥulal īni širgaru ḥulalu sandu uknū* (9) *dušū aban nisiḫti* (= *ZA. SUḪ*) *elmešu AN.TA.SUR.RA-a šuklulu* and in the Agum text (v *R.* 33, ii, 37, and iii, 5), for the shrines of Marduk and Šarpanit, and decoration of Marduk's crown.

aZA. ṬU is not very common in historical texts. Like *ḥulal īni*, it occurs in Agum's description of decorations (v *R.* 33, iii, 8 and 35); he is the first king to introduce a list of decorative materials which might almost be called bizarre. (I doubt if elsewhere can be found, in a historical text, such a combination as *aKA marḥaši arka* and *ḥulal īni*, the special *ḥulalu* for eyes.) Note also 'the year when the king Hammurabi constructed the throne of the great sanctuary with gold, silver, *aZA. ṬU.IGI*, *aZA. ṬU.MUŠ.GIR*, and *auknū* (Genouillac, *Prem. Rech. Kich Arch.*, ii, 42). Senn. (Bavian Inscr., 27) opens a canal with a dedication to Ea mentioning *asāndu* (red), *auknū* (blue), *aširgaru* (green), *aZA. ṬU* (= *ḥulalu*, white), *aPAR. AŠ* (alabaster): in *KAH.* ii, 122, 52 he accumulates for the decoration of the Temple of the New Year's Feast 'silver, gold, *asāndu* (red), *auknū* (blue), *ḥulalu* (white), *aširgaru* (green), *aPAR. AŠ* (alabaster), *aPAR. AŠ.AŠ* (chalcedony, or similar hard stone), *IM.SIG₇.SIG₇*, orpiment (bright yellow)'. The *uknū*-blue is probably a blue paint, and the *širgaru*-green is green verditer, the red is probably red ochre, the orpiment is a yellow earth, and therefore

¹ Or is it *ḥulal paṇi* ('for the face')? *CT.* xvii, 39, 48-50 apparently does not translate *aZA. ṬU.IGI* in the Assyrian: Mr. C. J. Gadd has been so good as to verify my copy.

there is no objection on the grounds of chemical colour to *ḫulalu* being the white lead paint of commerce. When Shamshi-Adad I decorates 'the walls' of his palace with 'silver, gold, *ʾuknú*, *ʾsámtu*' (i, 21: *IAK.* 22, 21) are we to suppose that he used actual pieces of these materials, or that he painted the bricks, as Anp.'s palaces showed this latter king did? Again, what exactly is 2 *duppani* [*a*] *ZA. ṬU* 1 *aPAR. AŠ. AŠ* 1 *IGI PAR. AŠ* '2 tablets of *ZA. ṬU*, 1 chalcedony, 1 bead of aragonite' occurring in Clay, *UMBS.* ii, 2, No. 105 (2-3).

But although *aZA. ṬU* is not common in Assyrian or Babylonian texts, we cannot say the same of Tushratta's lists of gifts from Mitanni. In *TA.* 25 *aZA. ṬU. KUR* occurs more than thirty times, and among the minerals which he uses as gifts (apart from metals), *aZA. GIN. KUR*, *aZA. ṬU. KUR*, *aŠÁR. GUB. BA*, *aSAG. KAL*, *a-marḫaši* (*a-marḫalim?*), *a-marḫallu*, *aZA. ṬU. MUŠ. GIR*, *ašmi(k)ki*, *aKA* and *aKA. KUR*, *aŠI. TIR*, *aapašmu*, *aAN. GUG. ME*, *a-dušú*, *aGIŠ. ŠIR. GAL*, the first three are far the most common. If *ZA. ṬU* is white lead, the propinquity of Mitanni to the lead mines of Keban Ma'den will explain the extraordinary frequency of the mention of it in the gifts from that land. Perhaps it is also worth noting that in modern manufacture the paste of white lead is allowed to dry in small conical forms (*EB.* 11th ed., xvi, 319). Some such explanation would be necessary for many of the decorated gifts of Tushratta, notably *aZA. ṬU. KUR ana aKIŠIB aZA. ṬU. KUR ina libbi-šu šukkuḫ 5 šiklu hurāši ina libbi-šu nadi* (*TA.* 22, i, 5).

In discussing any form of white lead it must not be forgotten that there is a natural form of white lead, cerussite, which effervesces under acid (*WM.* 151); Pliny (*NH.* xxxv, 19) speaks of this as found naturally at Smyrna, and used for painting ships. It occurs also in the lead mines of Keban Ma'den (*A.* 280) and of Ganjabad (between Kasvin and the lower end of Lake Urumieh) (Mactear, *TIM.* 1894, 9). But in any case, whether we have to account here for the natural cerussite or the prepared white lead, the propinquity of the lead mines to Mitanni is strong evidence in favour of some form of lead for the gifts from Tushratta (*mātu* Ir-kab is also given as a provenance (ii *R.* 51, i-ii, 14)). On the other hand, against 'white lead' as an identification of *aZA. ṬU* must be mentioned: (a) that *aZA. ṬU* may be prescribed once (or even twice) internally in *MT*. The first passage is *AM.* 4, 4, 2, but at the same time the text is so much mutilated that no certain evidence can be drawn from it; one *šu* of *ḫulalu* is prescribed with others (also in small quantities) and after the mutilated portions (beginning and end) of four more lines, directions are given for drinking (but whether for drinking this drug, cannot be said for certain). White lead is, of course, a poison (a fact which Pliny, *NH.* xxxiv, 54 knew, although he did not apparently know that acetate of lead was not necessarily so, as *TC.* ii,

90 points out). We can hardly suppose that the Assyrians, who were a careful people, did not know the difference between white lead (a poison), and acetate (sugar) of lead, which can be used internally in small doses (*P.* 911). It must be noted, however, that ceruse ('plumbi subcarbonas') 'is occasionally used medicinally by European practitioners in India as an astringent', (*MM.* i, 535), and the Syr. medicines include psymithium (white lead), about $\frac{1}{8}$ drachm in a four-drachm tablet to be injected for the spleen (*SM.* ii, 492, cf. 493). The second passage in *MT.* is also mutilated: . . . [^aG]UG(?) ^aZA.ṬU ina ša[mni(?)] . . . ^aazallī išatti-ma [iballut] (*AM.* 41, 2, 6).

It is worth noting that in mod. Indian medicine (*BMM.* 34) the difference between lead ore and carbonate of lead (ceruse) is carefully marked: the words for 'lead' proper are *nāga* (Skr.) and *anāka* (Pers.), while the carbonate, which is described as crystallized and massive in the natural state, and artificially made from vinegar, is called in Arabic *isfedja*, and in Persian *sufedāba*. The distinction between the two appears thus to be carefully kept by Orientals.

We have still to discuss ^aZA.NIM and ^aZA.SU, which, although used in early texts, are not, as far as I know, used in Assyrian times except in vocabularies. Both = *hulalu*, and if we are to find an equivalent for *NIM* and *SU*, the first, as meaning 'fly' or other winged creature, suggests that *NIM* may have the value of buzzing or hissing, which might be applied to the effervescence of acid on cerussite. *SU*, as 'body', might suggest weight, but this is doubtful.¹

To sum up: ^aZA.ṬU appears to be a heavy mineral, and, as contrasted with red, blue, yellow, and green in the historical texts, and with black in *MT.*, it must surely be white: *hulalu* can be referred to the root *h-l-l* meaning 'the acetated thing', which becomes *sāsu* 'red (lead)' when roasted: in *MT.* it is used on the temples, like ceruse in other lands, and there is a special kind for eyes, as Pliny indicates. It is used plentifully by Tushratta, as we should expect from his propinquity to the lead mines. Opposed to this are two doubtful texts in *MT.* which suggest a possibility of its being prescribed internally, but this use of white lead internally is paralleled in ancient Syriac and modern Indian medicine.

16 (b) ^aZA.ṬU as a determinative indicating effervescence in certain carbonates (their action under acid).

Besides meaning 'the acetated mineral', presumably white lead,

¹ A macehead adorned with lions' heads was made of *ḪAB.ZA.NIM* by Gudea (*ISA.* 111). Such a macehead made with lions' heads does actually exist (*ib.* 204), made of marble, and it is a question whether we are to see 'marble' here in *ḪAB.ZA.NIM* or 'white lead'. Gudea first makes it of *ḪAB.ZA.NIM* and then gilds it. It is hardly likely to be of solid white lead, nor is it likely that it is of some simple stone painted with white lead: but as we do not know what *ḪAB.ZA.NIM* is, and as ^aZA.NIM is rare, we can deduce little or nothing.

ZA.ṬU is also used in a way which suggests that it is a kind of determinative prefix to certain well-known stones, since these appear both with and without it, without apparent reason (for a list see No. 16 (a)). In the cases in which we find ZA.ṬU added to them in interlinear texts, it is important to notice that the Assyrian translation ignores this prefix entirely, making no attempt at a rendering (e.g. ^aZA.ṬU.MUŠ.GIR = simple *šir-gar-ru*, CT. xvii, 39, 48). In the cases of two of them, ^aZA.ṬU.MUŠ.GIR and ^aZA.ṬU.PAR.AŠ (from what we know of the simple ^aMUŠ.GIR and ^aPAR.AŠ), we can presumably accept that they are respectively green and white. But ZA.ṬU cannot here be regarded as qualifying the colour, for although green might be qualified, the same can hardly be said of white, and if ZA.ṬU really represents a colour-qualification in the case of green, we should reasonably have expected it in the case of blue (^auknū) and red (^asāndu), which is certainly not the case. Nor can ZA.ṬU represent a quality of hardness, for this is shown by a postpositive AŠ and AŠ.AŠ.¹

Clearly, then, ZA.ṬU prefixed to a simple well-known mineral name must add some contrasted distinction between the simple and the more elaborate forms, but not in relation to colour or hardness.

Now, since ZA.ṬU means 'the acetated thing' the well-known test of rocks composed of carbonates (the application of acid resulting in effervescence) at once suggests itself (see also OTC. 104). This effect of acid on nitre was well known to the ancients: 'as vinegar upon nether' (Prov. xxv, 20). The decomposing of rocks under acid (e.g. by Hannibal crossing the Alps) is discussed in *Hist.* i, 370 which quotes Pliny (*NH.* xxiii, 27) as saying that the hard stones met with in the mines are broken by means of fire and vinegar, and Vitruvius (viii, iii) as saying that if an egg is left in vinegar, its shell will soften. Galen, again (*De Fac. Simp. Med.*, i, 22), says that vinegar acts like fire in attacking stones, copper, iron, and lead. Although the tradition of Hannibal may be fantastic, it may certainly have grown out of a more simple trade secret, for this idea of destruction of rock under vinegar seems to persist from ancient times.

We can consider this peculiarity under each separate stone.

¹ It cannot be said that such initial groups as *IM.SAḤAR* or *IM.ŠIM* (in *IM.SAḤAR.KUR.RA* and *IM.ŠIM.BI.ZI.DA*) provide a parallel, but there is enough similarity in them to suggest that ^aZA.ṬU may justifiably be called a determinative.

17. THE WHITE STONES

- 17 (a) ^a*Amna*[*ku*?], ^a*PAR*, 'white siliceous sand' (see No. 2 (o)).
 17 (b) ^a*PAR.AŠ* 'harder white stone', alabaster (?) (hardness = 2), feldspar (?) (hardness = 6).
 17 (c) ^a*PAR.AŠ.AŠ* 'very hard white stone', chalcedony (hardness = 7).
 17 (d) ^a*ZA.TU.PAR.AŠ* 'harder white stone, effervescing under acid', calcite (hardness = 3): (possibly ^a*parātu*, No. 18 (a)).
 17 (e) ^a*ZA.TU.PAR.AŠ.AŠ* 'very hard white stone, effervescing under acid', aragonite, magnesite (hardness = 3.5-4), white marble.

'J' 73 provides a meaning ^a*am-na*[-*ku*?] for ^a*PAR*, hitherto known only in its Sumerian form. *Amnaku* is one of the forms for *immanakku*, *IM.MA.NA* (No. 2 (o)), so that presumably (although not certainly), we must restore the broken equivalence thus. On this ground, and also owing to the fact that 'white lime' or 'chalk' will effervesce under acid, these two latter possible values, which I suggested for ^a*PAR* in *OTC.* 97, may have to be relinquished. But ^a*PAR* certainly cannot mean sand in the Egyptian gifts to Burna-Buriash (*TA.* 122, 70, 71): 'a *sahharu*-vessel of ^a*PAR*, its name *watḥa*'. It may of course, mean here only 'white stone, called in Egyptian *watḥa*', which might in that case be any white stone of any hardness, and if this be accepted, it is futile to suggest the names of softer stones, such as gypseous alabaster (which does not effervesce under acid), or even steatite, as possibilities. Moreover, it is the harder form, ^a*PAR.AŠ*, which would appear to be alabaster (*H.* = 2).¹

^a*PAR* is not of frequent occurrence. It comes in the list *CT.* 6, 11, 30 *b*: and it is one of a series of magical substances of which the 'water' is used to purify the man under a tabu in *Shurpu* viii, 66: 'I cleanse, I make clean, I lave, I wash, I purify with the pure water of the Tigris, the Euphrates, sea-water of the broad seas, water of silver, of gold, of copper, of lead, of tin (antimony), of red stone, of blue stone, of white (lead), of ^a*PAR* (white sand), of ^a*PAR.AŠ* (alabaster?), of ^a*PAR.AŠ.AŠ* (aragonite)', &c. *AM.* 72, 1, 35 is definite in a similar ritual in directing that 'silver, gold, copper, lead . . . ^a*PAR*, ^a*PAR.AŠ*, ^a*PAR.AŠ.AŠ*, ^a . . . ' be put on the neck. ^a*PAR*, therefore, must remain presumably siliceous sand from the equivalence ^a*PAR* = *am-na*[-*ku*?] until further evidence is adduced.

¹ In Egyptian alabaster we have to see two possibilities: one, the carbonate of lime, the other, the sulphate, gypseous, the former effervescing under acid, the latter not. *AEM.* 173 says that although the Egyptians used the sulphate occasionally, it was the carbonate which was so largely employed in making vases, while, on the other hand, *PSG.* 58 declares that a vast number of Canopic jars exist in a stone identical with the Derbyshire alabaster, which *EC.* 78 says is of the gypseous kind. It is significant that, while ^a*ZA.TU.PAR.AŠ* and ^a*ZA.TU.PAR.AŠ.AŠ* exist, there is no ^a*ZA.TU.PAR.*

We can now consider ^aPAR.AŠ and ^aPAR.AŠ.AŠ. In OTC. 97 I tried to prove that AŠ and AŠ.AŠ, when suffixed to a stone, indicated the relative hardness, suggesting that the Assyrians had a hard scale, like modern geologists. This is borne out by (a) ^aZA.GIN, lapis (H. = 5:5 to 6), turquoise (H. = 6), followed by ^aZA.GIN.AŠ and ^aZA.GIN.AŠ.AŠ, *šipru*, properly sapphire (H. = 9) (although ^aZA.GIN.AŠ includes a 'golden sapphire' which must be a form of lapis: (b) ^aZA.TU.PAR.AŠ, a white stone affected by acids, as a seal-stone (see No. 8 (b-f)), must be harder than ^aPAR, either sand, chalk, or alabaster.

This is the modern scale of hardness:

- | | |
|-------------------------|---------------------------|
| 1. Talc. | 6. Felspar (orthoclase). |
| 2. Rock salt or gypsum. | 7. Quartz. |
| 3. Calc-spar. | 8. Topaz. |
| 4. Fluor-spar. | 9. Sapphire, or corundum. |
| 5. Apatite. | 10. Diamond. |

Diamond (No. 10) may be ruled out, as the Assyrians did not know of it, so that it is hardly remarkable that the stone *šipru*, sapphire, corundum, should be called 'the scratcher'. As scratching is the test for hardness, not only does this suggest that the *šipru* was accounted capable of scratching any other stone, but its synonym *kunuku* indicates that it was used for engraving seals.

Accepting ^aZA.TU.PAR.AŠ as 'the moderately hard white stone affected by acids', used as a substance for seals, the probability is that it is calcite (H. = 3), which is the oldest and commonest material for vases at Ur (UE. frequently, and particularly ii, 379), and it was also used for seals (*ib.* 338, 25: 339, 40: 340, 44, &c.).¹ But the simpler ^aPAR.AŠ is not so easy. We have first, I think, to realize that such a group as IGI ^aPAR.AŠ means 'bead' and not 'eye' of 'PAR.AŠ stone' (Introduction), so that we can at once eliminate 'agate' as a value (against Smith, JRAS. 1925, 39). It is true that the eyes for statues are sometimes made from agate (H. = 7), but as far as I know, there is no evidence that these are said actually to be of ^aPAR.AŠ. Cf. '7 IGI ^aPAR.AŠ, besides 1 *lulidanitum* (see No. 7 (g)), 6 IGI ^aPAR.AŠ, small, not set' (Legrain, UMBS. xiii, No. 80, obv. 18-19).

^aPAR.AŠ occurs thus: in AM. 20, 1, 31 ^aZA.TU (white lead) ^aMUŠ.GIR (serpentine) ^aPAR.AŠ, and ^aKA.GIG (black ochre) are to be 'bound' (*ŠAR*) on a thread, and then bound on the sick man's temples. Here there is no definite indication of 'threading' which is usual when beads are prescribed, but BBR. 74, 29 certainly points to ^aPAR.AŠ being threaded. It is curious to see among a group of thirteen minerals (KAR. 202, ii, 20, much the same as CT. xxiii, 34, 29) that while ^aPAR.AŠ.AŠ is included, ^aPAR.AŠ has been omitted.

¹ On the possibility of ^aZA.TU.PAR.AŠ = ^aparātu, see No. 18 (a).

^aPAR. AŠ and ^aPAR. AŠ. AŠ both occur *AM.* 29, 2, 7, 'to remove poison' (use uncertain): ^aPAR. AŠ with others to remove the 'Hand of Ishtar', *KAR.* 186, 32: and again, both occur, to be pounded and brayed in ointment and poultice for temples, *AM.* 102, 35, a rare use, and, judging by the number of hard stones included, entirely without medical value. ^aPAR. AŠ does not occur in what are certainly known as the gifts of Tushratta, from Mitanni: but Sargon certainly obtains ^aPAR. AŠ from Mušasir (N. of Assyria) (*HC.* 352). It came from Dulupiš and Dudpiš (ii *R.* 51, i-ii, 15-16), a text in which ^aPAR. AŠ. AŠ is not mentioned. *ABL.* 1194, gives *ša* ^aPAR. AŠ *ša ina bti niširti ša* ^{ilu}*Sin* 'Of the PAR. AŠ stone, which is in the treasury of the Moon-god' shows that the use of white stones for the Moon was prevalent in Assyria, as it was in later times among the alchemists. In *ADD.* 645 (8th-7th cent.) are mentioned an *algorit* of gold with a *tamlit* of ^aKA (some form of haematite), ^a . . ., ^asāndu (carnelian, probably), ^aPAR. AŠ, ^aPAR. AŠ. AŠ, &c. 2 ^aPAR. AŠ are sold for 4 shekels of silver (*Nbn.* 245, 12): ^aTAG. GAZ of ^aPAR. AŠ cost 25 mana of silver (Scheil, *RA.* 1926, 46): 'one *uz(?)*-ka-ri (crescent?) of ^aPAR. AŠ' was an ex-voto from Nebuchadnezzar to the Goddess Aa (*Nbk.* 280). Cf. also '12(?) ^a? PAR. AŠ *ina libbi 15 manditum hurāši*' (*Nbn.* 719). Clay, *UMBS.* ii, 2, No. 105, 45 mentions 2 *šā-an dup-ṣi* PAR. AŠ *iḫ-zu hurāši* 'two ? of PAR. AŠ set with gold'.

^aPAR. AŠ. AŠ will then be a harder stone still, which does not effervesce, probably chalcedony (H. = 7), while ^aZA. ṬU. PAR. AŠ. AŠ may be either white marble, or aragonite (H. = 3·5-4). Cf. Agum, v *R.* 33, (Col. ii) (36) *auknū šadī* ^aKA *Marḥaši arḫa* (37) *aḫulal ēni* ^aZA. ṬU. MUŠ. GIR (38) ^aZA. ṬU. PAR. AŠ ^aZA. ṬU. PAR. AŠ. AŠ (39) ^aénāti^{bl} *Meluhḫa* (40) ^aGIŠ. ŠIR. GAL (41) ^aŠAL. LA *akra u* ^aEL (42) *ša ina kašadi-šu nasku* (43) *ana ašrat* ^{ilu}*Marduk* (44) *u* ^{ilu}*Šarpanitum* (45) *lu addinu-ma*. Clearly here, although many of these minerals might be used as paint, ^aGIŠ. ŠIR. GAL, 'marble', certainly was not, so that we cannot define them as being in one and the same category. Hence ^aZA. ṬU. PAR. AŠ and ^aZA. ṬU. PAR. AŠ. AŠ may well be solid stones used in decoration.

The next quotation is the decoration of the crown (Col. iii): (1) *ša auknū u hurāšu* (2) *ina kaḫḫadi-šu* (3) *lū aškunu-ma* (4) *ina eli riš agi-šu* (5) ^aZA. ṬU. IGI. MUŠ. GIR (6) *aṁenišuti* (7) *lu aškunu-ma* (8) ^aZA. ṬU. ^aMUŠ. GIR (9) ^aKA *Marḥaši auknū* (10) ^aZA. ṬU. PAR. AŠ (11) *ina eli agi-šu* (12) *lū šainu*. Here the crown is made of lapis and gold, and on the top of it are placed 'Dragon's eye stone effervescing under acid *aṁenišuti*', while on the crown itself (round it) were white lead, serpentine (or sim.), ^aKA *Marḥaši* (a form of iron pyrites or ochre), and our white stone, aragonite or sim. It is, in point of fact, a composite crown, based on gold and lapis, with inlay of various others.

K. 1277 (Bezold., *Cat.*, 256) l. 14 mentions 'total 27 ^aPAR.AŠ.AŠ', and r. 7 'total 16 ^aPAR.AŠ.AŠ', r. 8 '10 mu-ta-an ^aPAR.AŠ.AŠ' (uncertain meaning).

To sum up: ^aPAR, although actually given a value ^aamna[ku] 'sand', has a value indicating something more solid as 'white stone' in *TA.*: ^aPAR.AŠ, harder, may be alabaster (H. = 2), or even feldspar (H. = 6): ^aPAR.AŠ.AŠ, as the hardest white stone not effervescing under acid, must be chalcedony (H. = 7). The two others ^aZA.ṬU.PAR.AŠ and ^aZA.ṬU.PAR.AŠ.AŠ, as carbonates, must be respectively calcite (H. = 3), and probably any harder white stone such as white marble (or aragonite H. = 3.5-4) which effervesce under acid.¹ Possibly ^aZA.ṬU.PAR.AŠ is ^aparūtu 'marble' (No. 18 (a)).

¹ Aragonite, white marble, and later chalcedony, were used for cylinder seals (*SC.* 6, 7).

18. MARBLE, ALABASTER, GYPSUM, PLASTER, AND LIME

18 (a) *Parûtu*, properly marble: *GIS.ŠIR.GAL*, alabaster. The two are sometimes regarded as synonyms.

18 (b) *Gaššu*, *IM.PAR.(RA)*, gypsum, plaster.

18 (c) *Namru*, *namrûtu*, *ZALAG(BIR)*, probably lime (less probably chalk).

18 (a). *GIS.ŠIR.GAL* occurs as early as the Epoch of Ur (Scheil, *RA*. 1921, 67). The difference between *GIS.ŠIR.GAL* and *parûtu* is actually kept down to late times. A late syllabary (Scheil, *RA*. 1918, 119: *TU*. vi, 36) gives in l. 25 *pa-ru-ut-tum* = *ŠU-ti* and in l. 13 *GIS.ŠIR.GAL* = *ŠU-lum*. Scheil, following Thureau-Dangin (*ZA*. 1903, 196, n. 4 and *OLZ*. 1904, 3) takes the *parûtu* to be Mosul marble (a calcareous gypsum *A*. 257), and *GIS.ŠIR.GAL* calcareous alabaster (a crystalline carbonate of lime), having shown definitely in *RA*. 1917, 89, that an axe of *ŠIR.GAL* (the same, doubtless, as *GIS.ŠIR.GAL*) is an effervescent calcareous stone (cf. also Meissner, *OLZ*. 1912, 147: Ebeling and Meissner, *Reallex.*, 436). Senn. says (*Luch*. 107, 54) that *GIS.ŠIR.GAL* in the time of his fathers was sufficiently precious to be used for sword-hilts (like the sardonyx of Pliny, *NH*. xxxvii, 23), but that in his time it was discovered in bulk in Ammanana. Ashurnasirpal, in avoiding the use of the word *GIS.ŠIR.GAL* in *AKA*. 187, 21 (where he describes the beasts which he makes as being from *pa-ru-te* and *pi-li pišé(e)*) thus shows, not only that *GIS.ŠIR.GAL* would really appear to be too rare as a material for colossi, but that there is an undoubted distinction between *GIS.ŠIR.GAL* and *parûtu*. On the other hand he describes his booty from Suri (near Kummuh, Commagene) as being silver, gold, bronze, iron, lead, *GIS.ŠIR.GAL*, and bowls overlaid, the *GIS.ŠIR.GAL* thus standing out as the one stone of obvious rarity (*ib*. 283, 83). Similarly he mentions the tribute of Hindani 'silver and gold and lead and bronze and šammu-stone and *GIS.ŠIR.GAL*' (*ib*. 287, 96). His son Shalmaneser obtained *GIS.ŠIR.GAL* in great quantity from the mountain of Muli in Tabał (*šad Tunni šadé(e) kaspi šad Muli šadé(e) GIS.ŠIR.GAL*) which must certainly be not very far from the silver mines of Keban Ma'den (i.e. *šad Tunni*) (*KAVI.*, 30, r. 2; cf. Shalmaneser's Obelisk, 106).¹ It is obvious that these kings would not have brought

¹ Meissner (*OLZ*. 1912, 148) suggests either the mines of Bulghar Ma'den in Cilicia or Bereketi Ma'den in the Ala Dagħ, and says that alabaster is found on the left bank of the Halys at Sari-Karaman-Dagħ. In *Muli* (he quotes) Leonhard would perhaps see the ancient Morimene. Sargon obtained *GIS.ŠIR.GAL ibbu* from Ammun, in the mountains to the N.W. (Winckler, *Keils. Sar.*, *Ann.* 202).

back such heavy stone as marble which could be found so easily near Nineveh. *GIS.ŠIR.GAL* is included among the gifts of Tushratta of Mitanni, whose country seems to have been within easy range of (if not actually including) the silver mines (*TA*. No. 25, ii, 45). Even as late as Nabonidus the material of a crown is given as *GIS.ŠIR.GAL* (v R. 63, ii, 37). In *MT*. it is naturally rare, but it does occur, prescribed to be drunk (?) for stone (??): one *šu* of *GIS.ŠIR.GAL* with one *šu* each of *ŠA.U.U*, *ZA.SUH.ID.ZID.DA* (a vitriol), *muša* (misy), and four *ši* of . . . (*AM*. 30, 12, ii, 6; cf. *AM*. 4, 4, 7). How far powdered alabaster (carbonate of lime) would affect the kidneys I cannot say: but below it will be seen that both *parūtu* and *GIS.ŠIR.GAL* can mean magnesite, and a magnesian limestone would certainly be a mildly purgative drug.¹

In omen texts '[if a woman] bears a child, and (its head) is white like *GIS.ŠIR.GAL*' Thureau-Dangin (*RA*. 1920, 30, quoting K. 6790, 10, *CT*. xxviii, 1) suggests alabaster.

The form *ŠIR.GAL* has already been mentioned. It occurs as the material of a macehead of Gudea (see Heuzey, *Cat*. 265: *RA*. 1891, 150: *ISA*. 204). The material was brought by Gudea from Tidanu, the mountain of Amurru (*ISA*. 109, vi, 13). *AS.ŠIR.GAL* occurs on the Hittite texts (*KTB*. iv, 1, 37, as coming from Kanišha: *KuB*, ii, 2, 24: *KS*. iv, 80, 37). 2 *GIS.ŠIR* occur on a Kassite tablet, of beads, &c., Clay, *UMBS*. ii, 2, 105, 35.

Emphasis is so frequently laid in the Assyrian texts on the shining nature of *GIS.ŠIR.GAL* that we must again infer that it was alabaster: *GIS.ŠIR* and *ŠIR* both = *nūru* 'light' (*D*. 71, 7): *GIS.ŠIR* is Shamash (*ib*. 19, d): Geller, *AOTU*. i, 4, 306, 5, *GIS.ŠIR.GAL* (translated *ditto*) is described as 'whereof the body shines like the day': cf. iv R. 57, 69 a, 'let my light shine like *GIS.ŠIR.GAL*'. Everything (its precious nature, its rare use for sword-hilts, the absence of any mention of it as a material for colossi, and its brilliance in poetic texts) points to *GIS.ŠIR.GAL* being white alabaster.

Turning now to *parūtu*, in the tablets of gold, silver, and magnesite of Sargon, while the last named (carbonate of magnesia, pure and crystallized, see No. 12 (a)) is described as *GIS.ŠIR.GAL*, (Lyon, *Keils. Sarg.*, pp. 24, 26, 27), this word is replaced in the Khorsabad Inscr. (*Gde. Inscr*. 160) apparently by *pa-ru-tum*. Now, although this represents a general equivalence of *GIS.ŠIR.GAL*, it provides no real evidence that the two words were accounted synonymous. But Senn. speaks of breccia, *GIS.ŠIR.GAL* and *pīli rabūti* (Luck., *Senn.*, 123, 36): Esarh. says (*PE*. 26, 7) that he girded the wall of his palace with *GIS.ŠIR.GAL*. These suggest that in the period of the later Assyrian Empire *GIS.ŠIR.GAL* might be used, perhaps

¹ *AM*. 32, 1, 4 is uncertain.

inaccurately, for marble. It must be noted also that *aGIS.ŠIR.GAL* (as definitely distinct from *a-parūtu*) in the late text quoted above (Scheil, *RA.* 1918, 115) is the substance from which *šalmu* (image), *lamassu* (guardian-colossus), and *kisallu* (courtyard) can be made.

Yet, while *aGIS.ŠIR.GAL* is almost certainly alabaster, and distinct from *a-parūtu*, in the Glass-texts of the 7th century there is some reason to suppose that *a-pa-ru-te* actually represents alabaster, rather than marble, where one part of *tuskū* (oxide of zinc) turns 360 parts of clear glass into *a-parūte aššaki* 'opaque alabaster', while $1\frac{1}{2}$ parts of *tuskū* make it into *a-sāndu aššaki* 'opaque red'. Here the clear glass is turned into something like a white stone of glassy appearance, which will probably be alabaster. Yet, on the other hand, in the Alchemist's text of 1600 B.C., the operator is encouraged not to be disheartened if such-and-such a result is *parūtum* (Appendix ii), which need not suggest alabaster at all.

A difficult question is whether *aZA.ṬU.PAR.AŠ*, the moderately hard white stone which effervesces under acid, is *a-parūtu* 'marble'. In 'K' 14 it is equated with *ŠU-u*, perhaps *parū* (for *parūtu*): gypsum plaster, which is made from Mosul marble (*parūtu*) is called *IM.PAR* 'clay of *PAR*' (or, 'white clay'), the reference of *IM* being to the adhesive quality of the plaster. *aPAR.AŠ* which does not effervesce under acid (being without *ZA.ṬU*), perhaps the gypseous alabaster, the sulphate, might lead us to see that *aZA.ṬU.PAR.AŠ* was the alabaster which does effervesce, i.e. the carbonate, in other words the equivalent of *aGIS.ŠIR.GAL* (which undoubtedly is this form of alabaster), presumed to be sometimes equivalent to *a-parūtu*. There are many names for these white stones, and in some cases we have certainly seen a confusion between certain of them which the more careful scribes have kept separate. Can we suggest, then, that *aZA.ṬU.PAR.AŠ* coincides sufficiently in substance to be used as a synonym for *a-parūtu*? The two do not, as far as I am aware, occur side by side in inscriptions.

aParūtu is one of the possible words connected with the Greek *πῶρος*.

To sum up: the distinction between *aGIS.ŠIR.GAL*, alabaster, and *a-parūtu*, marble, appears to be usually, but not always, maintained. *aZA.ṬU.PAR.AŠ* may perhaps be *a-parūtu*, but, again, this is by no means certain.

18 (b) Gaššu, IM.PAR, gypsum, plaster.

This is the Arab. *juss* (Jensen, *ZA.* 1894, 128), the white powder used for plastering walls, made by burning gypsum, which needs a heat of only 100–200° C. as against lime with 900° C. (which is not found in Egypt until about 323 B.C.) (*AEMI.* 78). *Gaššu* appears to have been made from *a-parūtu*, if I am right in translating a passage which may

have been mistranslated (Tigl. III, Nimroud 80, and cf. *AR.* i, 804) *askuppi IM. PAR* (= *gaššu*) '*pa-ru-ti ina šapli-šunu az-kup-ma*' 'thresholds (bases) of plaster of *parūti* (Mosul marble, calcareous gypsum) below them (i.e. colossi) I set'. Surely, if these two materials were meant to represent here two separate parts of the construction, the more important one, 'marble', would have been put first. Oliver (*Voyage*, iv, 268) notes that plaster was made at Mosul from the Mosul marble ('une sorte de gypse'). Actually, at Babylon, according to Chesney (ii, 626) the mortar between the burnt bricks is *juss*, calcareous earth, found in the desert W. of the Euphrates: a fine cement at the Kasr (Babylon) covers the bricks like a thin coating of modern stucco: 'borak' appears to have formed the substance of the plaster, which in its natural state is found in large craggy lumps resembling gypsum, and when burnt forms stucco or whitewash (*ib.* 626, quoting Rich, *Babylon*, 102).¹ The stucco of Babylonia and Persia differs little from the chunam of India: 20 lb. of molasses, one peck of gramm, one peck of myrabolans (Indian plums) (boiled separately), slaked lime, and fine frit sand (*ib.* 627). The cement used by Shapur was made of sheeps' milk, lime ('nawreh'), and white plaster ('gatch') (*ib.* 627). According to Pliny, *NH.* xxxvi, 59, gypsum is calcined in Syria with cow-dung.

Rich (*Koord.*, ii, 71) describes a gypsum mill worked at Bashika by mules with a roller, something in the nature of a corn-mill, and doubtless we must see a similar process indicated in iv *R.* 30, b, 14-15, *gašša ina šadī imisu* the gypsum being thus crushed (*emēsu*) 'in the mountains'.

Gaššu is used as a white paint for small clay figures in rituals (Sidney Smith, *JRAS.* 1926, 695 ff.): in Egypt plaster was also used as paint (*AEMI.* 291). Indeed, the white of gypsum represents the powers of good, as against the black of bitumen (see Epping-Strassmaier, *ZA.* 1891, 242; Langdon, *Sum. Lit.*, 339; Smith, *JRAS.* 1926, 706) 'the gypsum (and) bitumen which they rub on the door of the sick man's house, the *gaššu* is Ninurta, while the bitumen is the *asakku*-demon' (Smith, *ib.*, 713, says 'Compare the baker and the sweep'). Curiously the two substances are mixed in *Maqlū* ii, 169, to make a figure of the witch, and the introduction of the unflammable white gypsum is curious in contrast with the bitumen.

In *MT.* simple *gaššu* is used: for binding on the *head* (ten shekels of *lolium*, [ten] shekels of *gaššu*, ten shekels of flour of *ŠE.SA.A* (roast corn) steeped in rose-water (*AM.* 20, 1, 20): for painful *breast*, *epigastrium*, or *loins*, apply *lolium*, mucilage of sesame, . . . roses, flour of

¹ This is also described by Rich (*Mem. on the Ru. of Babylon*, in *Fundgruben des Orients*, iii, 161), where he says that, in the W. desert between Babylon, Hit, and Anah, is found a species of calcareous earth called borak, resembling gypsum in large craggy lumps of earthy appearance externally, but, being burnt, forming an excellent whitewash or plaster.

ŠE.SA.A (roast corn), *gaššu* . . . AM. 49, 4, 4-5): in a poultice for a swelling (AM. 73, 1, 16). It is used with river water for washing hands (KAR. 92, 27), and 'reduced' and brayed, anointed in oil (KAR. 204, 9), and included in a fumigation for the head (CT. xxiii, 26, 10).

It is interesting to see the special term *bašla* 'boiled' applied in Assyrian times to *gaššu*, just as 'boiled' is applied to plaster to-day (EC. 399). In MT. this 'boiled plaster' is applied ext. for the trouble called *lamšat hīlati*, apparently a form of skin trouble: *gašša ba-aš-la epir utumi taḥašal tašaḥal* 'boiled gypsum (and) dust from the oven thou shalt pound (and) sift' (AM. 44, 1, ii, 11: cf. also l. 7: ȝSOR. 1931, 57): and for head alone in almond oil (AM. 2, 1, 7+CT. xxiii, 25, 32). ZID.IM.PAR, KAR. 192. r. ii, 49, 'powder of gypsum' is used for a bruise, or sim.

Probably IM.PAR.PAR.RA is a form of the same word (ISA. 156, 8), and also IM.PAR.PAR (TURK. 113, vi, 6, SLT. 88, 3: Scheil, RA. 1921, 6: all early). There is also the special IM.PAR *Purattu* ('of the Euphrates'), CT. xxiii, 44, 3, to be bound on temples and eye, with various kinds of flour in rose-water, which is obviously the special *juss* found near the Euphrates mentioned by Chesney (p. 149)¹ and a special IM.PAR of *adbaru*, apparently the calcined pumice (see No. 21 (e)).

18 (c) Namru, namrûtu, ^aZALAG(BIR), probably lime (less probably chalk).

The important point about lime is that, while gypsum can be burnt at a heat of 100° C. to 200° C., as much as 900° C. is necessary for lime (and that is why in Egypt there is no lime-mortar before 323 B.C.) (AEMI. 73, 78).² With this in view we can consider ^aZALAG as possibly lime.

¹ Can this be the same as the 'earth of the town of Ubasê', included in the building of the first Adad-nirari's *mušlal* and quay (AR. i, 79 and 85)? The phrase for reinforcing the work is 'with *pīli* (limestone) and earth (*ipri*) from Ubasê'. AIK. 70, n. 2 points out that Delitzsch identified it with Tell *Huwêš*, 14 km. N. of Ashur, on the Tigris, while Andrae would make it *Ķayara*. But this latter would suggest bitumen, for which substance we have enough Assyrian words without calling in the help of paraphrase: it is more probably a special form of cement. AIK. quotes Forrer, *Die Provinzant.*, 105, and ABL. 433, 4, the latter being a letter to the king (probably Sargon, since Dur-Sargon is mentioned r. 10), which after compliments, begins 'The first day after we left the palace we reached the town of Ubasê; the boats (rafts) were excellent (or, are in good condition)'. A kelek takes from four to ten days to reach Baghdad, according to wind and water, so that this journey (which may mean their arrival on the second day out) is not difficult.

² At Nineveh it is in my recollection that it was only buildings a long time post-Assyrian which were so strongly mortared together as to need the application of a crowbar and hammers for their removal. The Assyrian buildings had no harder plaster than could easily be removed with the ordinary pick. Layard

^a*ZALAG* = *nam-ru*, 'bright' 'G' 16; if Mr. Gadd and I are right in reading the fifth component of the glass in the Alchemist's Text (Appendix ii) as *ZALAG (BIR)-ram*, *namram*, the use of this chemical (which we have translated 'lime' here), goes back to the sixteenth century B.C.

In the later Glass-texts, of the seventh century B.C., in order to make *siršu*, a special glass, the components are:

- 60 parts sand
- 180 parts alkali
- 5 parts saltpetre
- 2 parts *namrûtum* (Sect. CC, Appendix i).

A special form of this is *siršu natku*:

- 60 parts sand
- 75 alkali
- male saltpetre (amount not given)
- 1½ parts *namrûti* (Sect. P, Appendix i).

Namrûtu, or *namrûtu* of the sea, is added frequently in small quantities to the glass (Sects. F, G, H, R, S, T), even where a glass already containing it forms part of the melt and particularly noticeable is it in Sects. T (= BB), where *dušû*, 'crystal' is to be made. The components are:

- 60 parts sand
 - 180 parts alkali
 - 6 parts saltpetre
 - ½ part *namrûtum*
 - 3 parts spodos
 - ⅓ part pompholyx
- } impure oxides of zinc, &c.

The two most important components of glass after sand and soda are lead or lime, saltpetre being used to purify it, and of lead or lime it may be said that lime is by far the more probable in Assyrian glass. 'Lead' (*abarû*) is included in the Alchemist's Text (Appendix ii) in his glaze; in the later Glass-texts it is not common, but *abarû* does, however, occur in small quantity (probably as antimony), in making the purple of Cassius (?) (Sect. DD) and in Sect. U (Appendix i). It is a curious thing, but lead does not appear to have been very common in ancient glass: 'Notwithstanding the use of oxide of lead by the ancients in their coloured glasses and artificial gems and enamels, the lightness of the fragments of their white cut glass indicates the absence of lead from the constituents of much of the ancient artificial crystal' (Pellatt, 78).

(*Nin. and Bab.*, 655) (of Esarhaddon's building) 'floored with thick lime-plaster cement', but 'a fine white mortar' of Nbn. at Babylon, *ib.* 505. Smyth (YT. 100) mentions lime kilns at Arghana.

Dillon (26, note) also says that Professor Buckman in 1851 noted the absence of lead in his analysis of ancient glass. In the following analysis of specimens of various ancient glass by Klaproth (quoted by Pellatt, 76) the use of oxide of lead in fairly large proportion does not appear to be an essential in the composition of this glass since it does not occur in the blue specimen, and yet is found in the red and the green.

	Red Glass	Blue Glass	Green Glass
Sand	162	163	130
Oxide of copper	15	1	20
Oxide of lead	28	..	15
Oxide of iron	5	19	7
Alumine	2	3	11
Kalkerde, lime	3	05	13

In Lucas's tables of the components of Egyptian glass (*AEMI*. 421 ff.) in seventeen analyses of various periods, only five contain oxide of lead. It is clear, therefore, that the probabilities in Assyrian glass suggest lime for the third component rather than lead.

That *namrûtu*¹ is the lime of Assyrian glass thus seems probable, especially as we have the addition of 'of the sea' attached to it in Sects. F, H, which suggests the lime made from shells. That *aZALAG*, *namru*, is the same would appear also to be probable: the Arab. *nûrah* (*nawrah*) 'lime' is a good cognate. In *MT*. we find *aZALAG* about 21 *tt.*; ext. in the following: for *eyes*, *AM*. 12, 4, 4: 14, 3, 5: 18, 9, 2: *eyes, temples*, 102, 17 (cf. *KAR*. 182, r. 8): *eyes, temples, neck*, 97, 4, 26: (dup. *KAR*. 182, 10, and *CT*. xxiii, 44, 3): *temples*, 14, 4, 6: 102, 21: hang on *neck*, 4, 6, 6: 7, 1, 5: 46, 1, 26: against *ghosts* (bind on, probably) 29, 1, 5 (+89, 3+*CT*. xxiii, 22): *ext.*, 33, 3, 1 (cf. 70, 2, 22: 93, 1, 5): 94, 2, ii, 15, 19: against *Hand of Ishtar*, *KAR.*, 186, 37, 38, 40: *hinikti KU. GIG* (retention of anus), *AM*. 40, 5, iii, 19. Included with petroleum in fumigation, *AM*. 103, 7 (quicklime has an unpleasant smell): as an injection (?), venereal, 66, 7, 1. What is noticeable in these prescriptions is the frequency of *aZALAG* in composition with *a^{mu}sû*, sulphate of iron (or copper), used ext., indicating an astringent application particularly for eyes. Moreover, since this sulphate is used, the remedy is intended for the 'inveterate granulations of the eyelids' and to 'prevent the spreading of serpiginous and putrid ulcers' (Pliny, under *misy*, *NH*. xxxiv, 31). Here we can note the use of lime in Pliny (*NH*. xxxvi, 57) quoted in almost the same words as for *misy*, 'it prevents

¹ In *OTC*. 17 I suggested 'chalk' for *namrûtu*, but I now think that 'lime' is practically certain. Besides, if we relinquish 'chalk' here, we have a satisfactory equivalent left for *a^{mu}PAR*, although it is true there is already an equation given as *a^{mu}anna[ku(?)]* 'sand(?)'.

serpiginous ulcers from spreading'. Lime can be introduced into glass either as quicklime, air-slacked, or as carbonate (marble, chalk), and the only question here is how it is used in *MT*.

To sum up: ^a*ZALAG*, *namru*, is similar to the Arab. *nûrah* 'lime', and the use in *MT*. is compatible with that of lime: *namrûtu*, which must surely be the same as *namru* (cf. *ZALAG-ram* in the Alchemist's Text),¹ can surely be nothing else than lime in the Glass-texts. The fact that the Assyrian and Babylonian kings did not mention this in their building inscriptions coincides with what would be expected from the late use of mortar in Egypt: that it could be used in *MT*. and Glass-text is easily explicable, since only a small quantity was wanted.

¹ And for a parallel *lulû* and *lulûtu*.

19. THE GREEN STONES

19 (a) ^a*Širga(r)ru*, ^a*MUŠ.GIR*, serpentine or green feldspar.

19 (b) ^a*ZA.ṬU.MUŠ.GIR* (= ^a*širgaru*), malachite, green calcite, green marble.

19 (c) ^a*Eni širgarri*, ^a*ZA.ṬU.IGI.MUŠ.GIR.*, Persian smaragdus(?).

19 (b) and (c) occur CT. vi, 11, i, 51, 52. On 'K' 12 [^a*ZA.ṬU*.*MUŠ.GIR* = *šir-gar-ru*. The reading ^aš[-i]r-ga-ru-ú (Scheil, *MMA*P., xxi, 29 a composite from various texts) makes the reading ^a*širgaru*, and not ^a*mušgaru*, practically certain. My comparison between this word and *σμάραγδος* (OTC. 96) is dependent on the value *MUŠ.GIR*, unless *širgaru* is a possible original of the Greek word.

That both are green stones seems certain from the evidence (OTC. 94). The *širgaru* was some kind of reptile, and therefore Boson (*It.* 407) was correct in his identification *ὄφίτης*, serpentine. Pliny also speaks of *molochitis* as coming from Arabia, highly esteemed for making seals (NH. xxxvii, 36). Jensen (*ZA.* x, 1896, 370) derived the word 'malachite' from the country *Meluḥḥa* (Arabia or Sinai), but in this instance it was the red *sāndu*-stone which he took to be the malachite, not the ^a*širgaru*, and it must be noted that Agum (v *R.* 33, iii, 5 and ii, 39) speaks of both ^a*ZA.ṬU eni širgarri* and ^a*ênâte¹* *Meluḥḥa* (see p. 156), which would show a distinction between the two. Pliny mentions yet another mineral which takes its name from a reptile, *batrachitis*, from Coptos (NH. xxxvii, 55).

That ^a*ZA.ṬU.MUŠ.GIR* was a hard green stone appears to be equally certain from the list of materials for seal cylinders (No. 8 (b)). It occurs in Agum's text (see above). By our theory of the prefixes *ZA.ṬU* indicating a carbonate, this mineral should be one of them, and hence it may be either malachite, green calcite, or green marble.¹ We shall, however, have to explain an anomaly in this value for ^a*ZA.ṬU.MUŠ.GIR*, if our theory about ^a*ZA.ṬU* is correct.

^a*MUŠ.GIR*, *širgaru*, simple, is used in the dedication of Sennacherib's canal (Bavian, 27, *Luck.*, *Senn.*, 81), ^a*GUG* ^a*ZA.GÌN* ^a*MUŠ.GIR* ^a*ZA.ṬU* ^a*PAR.AŠ*, i.e. red, blue, green, white(-lead), white stone, which confirms the view that it is a green stone, and possibly one used as a paint. It is one of five used for 'favour of Adad' (*KAR.* 213, 8), for averting divine anger (*ib.* 14, and 20), and against 'all evil' (*ib.* ii, 18). A male form occurs K. 3010, ii, 15. Simple ^a*MUŠ.GIR* could be powdered (and so probably used also as paint), *AM.* 16, 3, 11, where it is prescribed alone for eyes in *ḫimetu*-ghee, and this must almost

¹ Beck says that malachite is very rare for beads, but he adds that it possibly corrodes away. Green marble, Ménant, *Cat. des Cyl.*, 61, 124, 130, &c.: 'calcaire vert', *ib.* 110: green steatite, Delaporte, *Cat.*, ii, 200.

certainly be the *dahnaj* (malachite) of Ar-Razi (Stapleton, *MASB.* 351; cf. Ahmed Teifaschi, *De Gemmis* 44, ed. Ravius), a 'green stone which is used for signet rings and beads', which Stapleton says is basic carbonate of copper: 'the Stone-book states that it is only found in copper mines. It hardens gold, and is an antidote to poison and the stings of scorpions and bees' (*ib.*). Von Hammer, *Mines*, vi, 112-42 quoted *ESR.* i, 75, speaks of the Persian 'dehneh' malachite. Rich (*Koord.*, ii, 29) mentions that at Mosul a substance called *dehneh* or *dehlj*, produced in a gold mine in the mountains of Hakkaie in Kurdistan, is used as a remedy for the eyes in powder, and he goes on to say that it coincides with what Haüy calls granuliform carbonate of copper, blue and green, and that it effervesces in nitric acid. Clearly this *dehlj* (*dahnaj*) might be the green drug ªMUŠ.GIR used for eyes in *MT.*¹ Diosc. v, 115 speaks of chalcitis, green copper stone, for eyes. It must be the chrysocolla of Pliny (*NH.* xxxiii, 26, Bostock, vi, 107) of which the best was procured from the copper mines, the next best from silver mines, the third quality from gold mines, and that least valued from lead mines: it is 'green verditer' as a paint (*PC.* vii, 504), the green most approved by the ancients (Wm. Smith, *Dict. of Gk. and Rom. Antiqs.*, 263), and Pliny actually prescribes it as an eye-salve (*ib.* 28).

But if we have a carbonate of copper here, similar to green verditer, indicated without the prefix *ZA.ṬU*, it is contrary to our theory that *ZA.ṬU* indicates the effervescence of a mineral under acid. Yet in the instance given above (from Sennacherib), the use may be careless, since it is in a historical text: while the one instance in *MT.* may be due to an accidental omission; or, alternatively, it may be that the Assyrians were careful about adding this prefix only when there was a doubt or difficulty about the actual mineral.² The Assyrian doctor was perhaps so well aware that the use of *dehlj* was the only correct one for the eyes, that he did not trouble to define it by spelling it out with the full prefix. In the same way he uses ªuknû simply for the blue carbonate (in any case, however, ªZA.ṬU is, curiously enough, never used as a prefix to ªZA.GIN), and perhaps where, on the one hand, the physician would understand that blue carbonate was intended in his prescriptions, on the other a jeweller would know professionally without further indication whether lapis or even turquoise was meant. But properly the simple ªMUŠ.GIR will mean a green stone not effervescing under acid, such as serpentine (used in Egypt and Babylonia), or Amazon-stone, green feldspar, used in Kassite times (*SC.* 5, 8), or green jasper (fairly common as a bead), or green chert (uncommon) (Beck).

¹ *Dehlj* may also be a form of *uknû*, a blue copper carbonate, see No. 15 (a).

² Indeed, it is possible that there is a parallel omission in the mineral ªiṣṣuri, ªḪU, ªZA.ṬU.PA.ḪU.NA (20 (a)) which thus apparently shows both forms, with and without.

The stone ªMUŠ.GIR is said to have come from the mountains of Akkala (almost certainly) and Malikanu (ii R. 51, iii-iv and i-ii, 14, 15, both unidentified), and in Persian times from Sugdu (Sogdiana) (MMAP. xxi, 8, 26).

The next mineral is ªZA.ṬU.IGI.MUŠ.GIR, surely to be kept distinct from IGI.ªZA.ṬU.MUŠ.GIR (which must mean 'bead (or similar) of malachite').¹ Agum includes ªZA.ṬU.IGI.MUŠ.GIR in the top of the crown which he made (v R. 33, iii, 5), which, with the meaning of the stone, looks as if a gem were intended. It cannot be our emerald, partly on the grounds of provenance, and partly because the emerald is not affected by such acids as the Assyrians had;² the explanation may perhaps be sought in Pliny (NH. xxxvii, 18) who mentions a form of smaragdus called 'Persian', which has, in its colouring, a resemblance to the eyes of cats or panthers.

To sum up: ªMUŠ.GIR, from its name as one of the reptiles as well as its juxtaposition to minerals indicating red, blue, and white, is a green stone, such as serpentine, or green feldspar: the form ªZA.ṬU.MUŠ.GIR, which should indicate a carbonate, will be malachite, or similar, but the distinction, which the use of ZA.ṬU as a prefix indicating this carbonate should afford, appears in one medical text at least not to have been kept. What ªIGI.MUŠ.GIR 'dragon's eye' is (except that it must be a green stone) is not certain.

¹ Tushratta sends thirteen *ênâte*^{pl} ªZA.ṬU.MUŠ.GIR *ḥuraši uḥḥuz ša ḫatī* (TA. 25, ii, 19) which would appear to be beads or jewels set in gold; ABL. 340, 11, mentions 26 *ênâte*^{pl} ša ªširgarri (without ZA.ṬU): Legrain (UMBS. xiii, No. 80, 6) gives 1 *erum ḥuraši ša ganandi* 5 IGI.MUŠ.GIR *ra-ki*. . . 'a gold box with cover five eye(s) of MUŠ.GIR': and Clay (UMBS. ii, 2, No. 105, 16) gives '6 *tam-ḫi-in PAR.AŠ* 3 IGI.MUŠ.GIR. ªIGI.MUŠ occurs in a vocab. (SLT. 125, 3), and as one of seven for UR(?) AN.KAL ID.TUK.TUK (. . . *lamassu nimelu iši*), KAR. 213, iii, 19.

² Lucas (AEM. 168) says that turquoise has been used in Egypt for more than 5,000 years, but in the translations given by Breasted, no mention is made of it, a lack which appears to have been caused by a confusion between turquoise and malachite: 'the Egyptians themselves, however, may not always have differentiated between the two, inferior greenish turquoise not being very unlike malachite . . . and both being obtained from the same locality'. But, as turquoise will not meet the test of acid, it is here out of the question.

20. OTHER MINERALS INDICATED BY THE PREFIX ZA.ṬU

20 (a). ^aIṣṣuri, ^aḪU, ^aZA.ṬU.PA.ḪU.NA, *ša kappi iṣṣuri*. 'B' 16: 'F' 5: 'K' 9. 'Birdstone', 'Bird's feather stone susceptible to acid'. It occurs KAR. 213, 1, as one of seven 'for the favour of Anu'. I suggest that it may be the *Smaragdus Medicus* of Pliny (NH. xxxvii, 18) 'These stones are wavy, and represent various natural objects, such as, for example, poppyheads, birds, the young of animals, and feathers'. King (PSG. 235) says that this is malachite, which is susceptible to acids. The pictured specimen of malachite in WM. pl. 19, 4 certainly confirms this comparison to feathers.

It will be noticed that the definition ZA.ṬU is not used except in the longer description of this stone, and this would certainly confirm p. 155, that ZA.ṬU is not always an essential.

20 (b) ^aZA.ṬU elallu, see ^aalallu, No. 21 (b).

20 (c) ^aZA.ṬU madallu.

'K' 11: in CT. VI, 11, i, 50, ^amadalum, uncertain.

20 (d). ^aZA.ṬU.ID.ZA.SUḪ, see No. 9 (d), (6).

21. STONES USED IN CARVING AND BUILDING

- 21 (a) ^a*Pîlu*, ^a*NA.PUR*, limestone: ^a*pîlu pišû*, white limestone.
 21 (b) ^a*Aḷallu*, ^a*elallu*, ^a*ZA.ṬU elallu* (^a*E.LI.EL*), a form of (yellow?) limestone.
 21 (c) ^a*Parātu*, ^a*GIŠ.ŠIR.GAL* (marble and alabaster): *gaššu*, *IM.PAR* (gypsum plaster), see Nos. 18 (a) and (b).
 21 (d) ^a*Galala*, marble.
 21 (e) ^a*Aḍbaru*, ^a*šalamtu*, ^a*AD.BAR*, ^a*uḫulu*, ^a*ELTEG*, basalt, lava, pumice (*uḫulu* represents the cinder of the *uḫulu*-plants).
 21 (f) ^a*Kašurrû*, ^a*GA.ŠUR.RA*, basalt.
 21 (g) ^a*Ušû*, *ESI*, diorite, dolerite.
 21 (h) ^a*Ašnan*, ^a*AN.ŠE.TIR* (^a*ŠE.TIR*, *ŠI.TIR*?), garnet (?), the matrix containing garnet(?) (probably here basalt or other rock at Jezirah).

21 (a) ^a*NA.PUR* = *pîlu* = *abnu pišû* (*pizû*) 'white stone'.

'C' 29: 'D' 8. Jensen compared Armen. *buṛ* 'Kalk' (*KB*. vi, 449). Long identified as limestone (for lit. see *MA.*, s.v.: and finally, Andrae, quoted *IAK*. 69). Idadu-Šušinak made a calcareous bowl of ^a*pu-lu* (*MMAP*. vi, 17, 53): *pîli* is mentioned by Ashur-uballiṣ I (*IAK*. 39). ^(a)*Pîlu* varies with ^(a)*pîlu* (iv *R*. 39, r. 6: Adad-nirari I, *KAH*. ii, 35, 30 and *AKA*. 8, 6: *IAK*. 70, No. 3, 6, A with B and C, and 72, No. 4). TP. I uses *pu-li* and *pu-û-li* (vii, 84). Cf. *AM*. 1, 2, 13, 'dust of the threshold of ^a*pûli* of an old house'. Senn. describes the walls of Nineveh (*Luck*. Senn., 96, 77) *askuppāt aḫīli rabbāti asurru-šu ušāšhira udanna šupuk-šu* 'with great blocks of *pîlu*-stone I girdled its wall, (and) strengthened its structure'. At the present day illicit exploitation of the walls of Nineveh shows that they are based on an enormous quantity of great, rough limestone blocks each as much as two men can lift. Esarh. (*PE*. 25, 52), describes ^a*pîlu* as *aban šadī(i) danni* 'the solid stone of the mountain', using it in foundations, and Abp. uses the word for the greyish limestone slabs with which he paved both the Temple of Nabû and the Temple of Ishtar of Nineveh (*Arch*. 1929, pl. xliii, and p. 120). From this we may infer that the *aban šadē*, ^a*KUR.RA* ('Kalkstein', Kolde- wey, *Wiss. Ver. d. Deutsch. Or. Ges.*, 2), in the Aiburshabu-road is the same. Cf. *CT*. xiv, 93084, 2.

The adjective *pišû* is used to define this word *pîlu*: e.g. the stone blocks at E. Šarra (Meissner, *MVAG*. 1903, 3, 22), which Senn. brought from Tastiâte, W. of the Tigris (*Luck*. 104, 64: 118, 9), and from Balatai, near Nineveh, in abundance (*ib.* 108, 62: 121, 49: 126, 1: &c.). Cf. also 2 *naḫiriš^{pl}* 4 *purḫiš^{pl}* 4 *nēšē^{pl}* ša ^a*AD.BAR* 2 *šēdu lamassu* ša ^a*pa-ru-te* 2 *purḫiš^{pl}* ša *pi-li pišē(e)* (Broken obelisk, *AKA*, 146, 16): *umam šadē^{pl}* u *tamāti^{pl}* ša *pi-li pišē(e)* u ^a*pa-ru-te* (Anp., Kalah, *ib.* 187, 21): *šalam bunani-ia* ša *api-li pišē(e)* (Anp., *ib.* 296, 5). Doubtless we

may compare the winged bulls and lions of coarse grey limestone at Nimrud (NR. ii, 315). Senn. made bull-colossi of ªGIŠ.ŠIR.GAL and bull- and cow-colossi of ªpîli pišē (CT. xxvi, pl. 28, vii, 22).

ªPîlu (pîlu) is thus limestone, with ªpîlu pišû more definite, probably to distinguish it from the yellow kind.

21 (b) ªAlallu, ªelallu, ªZA.ṬU elallu, ªE.LI.EL, ªE.LAL.LU (KAR. 14, iii, 4), probably a yellowish limestone.

ªZA.ṬU a-la-lum, ªZA.ṬU ù-la-lum occur CT. vi, 11, 48, 49, so that both words are old. ªZA.ṬU elallum shows that it was a carbonate ('K' 10). ªAlallum, 'H' 16: probably ªelîli (ªDUB elîli, ªḪAB elîli) Langdon, UMBS. xii, No. 14, ii, 7-9. Senn. (Arch. 1929, 135) describes ªalallum as ša kima . . . 'which is like . . .'. In BA. iii, 256, 22 (Meissner-Rost) Esarh. includes it among tablets of silver, gold, copper (siparru) lapis, alabaster (ªGIŠ.ŠIR.GAL), black basalt or similar (ªšalamtu), some feldspatho-pyroxenic rock, basalt or sim. (ªašnan), and white limestone, and he also made a širruš-dragon of it (the širruš at Babylon is white, except for the yellow mane, ruff, horn, and claws, Koldewey, Das wied. ersteh. Bab., pl. 32). His ªalaldu (Cyls. A and C, vi, 21) is obviously a mistake; he provides ªGIŠ.ŠIR.GAL (alabaster), ªašnan (matrix of garnet), ªTUR.MI.NA, ªTUR.MI.NA.BAN.DA (breccia) ªEN.GI.ŠAḪ, ªalaldu (!), ªGI.RIM.ŠÁR.GUB.BA. The invocation to the ªalallu (Geller, AOTU. i, 4, 302, 49 ff.: KAR. 14, iii, 4 ff.), although not always explicable, shows that the stone was used for inscriptions, and for the pavement of buildings: (7) parši-ia ina zumri-ka lišteširu 'my law upon thy body (i.e. inscribed on thee) may they fulfil (direct)', and (11) ina kisalmaḫi kigalla lû ramâta 'in the great court mayst thou be laid as a foundation'. In MT. it has no value as a drug, being worn against poison (AM. 91, 1, 1: AM. 7, 1, ii, 2 is apparently sim., but use uncertain): against pestilence, KAR. 213, iii, 20. It is followed by ªŠÛ a-lal-lum (two lines below it), CT. xiv, 16, 93804, 10-12.

It does not appear to be used in building inscriptions in Assyria until Senn.'s time, two centuries after Anp., pîlu becoming later qualified as pîlu pišû ('white pîlu'). Philologically alallu looks like the modern Mosul helân, a form of limestone, a word which my diggers at Nineveh used. A piece which Major Wilson was so good as to send me is of a lighter colour than the rather dingy limestone used by Ashurbanipal for the temple pavements (pîlu) at Nineveh. Since our evidence for ªalallu shows that it was a carbonate, and could be found in quantities large enough for inscriptions and pavements, and is used in the same inscription with pîlu pišû 'white limestone', we shall probably not be wrong in seeing it as a limestone, philologically connected with the modern helân. 'Colossal figures in yellow limestone' are mentioned, Nin. Bab., 654,

and 'a bright yellow limestone' for building (NR. ii, 314), both at Nimrud. (Layard, however, could not find the original quarries). Perhaps the colours on the *širruš* suggest a yellow tinge for *²alallu*.

21 (c) ²Parûtu, ²GIŠ.ŠIR.GAL (marble and alabaster): gaššu, IM.PAR (gypsum plaster), see No. 18 (a) and (b).

21 (d) ²Galala, marble (a late word).

On a marble inscr., time of Darius (Scheil, *MMAP*. 1929, xxi, 60), (cf. *ib.* 8, l. 31). Scheil (*ib.*) quotes a letter from Erech (Clay, *YOS*. iii, 1, No. 4) *asuminêti šina ša galala* (no det.) 'these tablets of *galala*'.

21 (e) ²Adbaru, ²šalamtu, ²AD.BAR, ²uḫulu, ²ELTEG, basalt, lava, pumice. 'A' 34, 35: 'C' 13, 18, 19: 'F' 14. Most important is 'C' 13, ²ELTEG = *aban uḫuli* (²uḫulu) = *adbarum* (²ELTEG occurs *SLT*. 125, 2).

First, ²AD.BAR *kišir šadê* (Thureau-Dangin, *Arslan Tash*, 63, l. 23, and 86, l. 2) is the description of the material of the basalt lions found by M. Thureau-Dangin at Arslan Tash, an identification, as M. Thureau-Dangin has pointed out to me, anticipated by Andrae. Cf. the Broken Obelisk (*AKA*. 147) 'four lions of ²AD.BAR (basalt), two colossal bulls of ²parûte (marble), two *purḫiš^{pl}* of ²pîli pišê(e) (white limestone)'. This is confirmed by the other equivalence [*š*] *a-lam-tu* ('C' 18) 'the black stone' (the *šalamdu* of Esarh., Meissner-Rost, *BA*. 1898, 256).

But there are objections to a definite identification with basalt only. In *MT*. directions are given for 'seven' and 'four calcinings'; ²AD.BAR *ša 7 BIL-šu* (*KAR*. 194, ii, 10 (cf. *KAR*. 194, iii, 2, ²AD.BAR *ša 4 B[IL-šu]*), the method of employment being lost. Then the 'powder' is used in application for menorrhagia, cf. ²maštakal (tragacanth, a white gum), and *A.GAR.GAR.AN.ĪD*, bitumen (a black substance), being sprinkled with *sikti* (powder, *ṽRAS*. 1931, 17) of ²AD.BAR, wrapped in red and white wool, and put into the vagina as a pledget, similar to the modern methods of plugging the vagina with cotton wool (*DM*. ii, 968). Here the white gum represents the powers of good, the black bitumen the powers of evil, and the red and white wool the blood, and the healthy condition, respectively. The addition of powdered ²AD.BAR to the two glutinous substances must be as a styptic, as it doubtless is in the first quotation. Indeed, simple ²AD.BAR is prescribed for *menorrhagia*, on a pledget of wool, with others (*KAR*. 194, 23): bind on 'middle' (pubes), *ib.* 31, 40, 47. Uncertain; a *LAL-te* (= *šimitte* (?), bandage, (?)) of ²AD.BAR, &c., *AM*. 46, 5, 3: a *ḪU.ŠIR* of ²AD.BAR to hang on neck in a purse, *AM*. 67, 2, 3. For stomach (*ḫuṣ libbi*) ext., with others, *KAR*. 186, 11. There is a mill made especially of it or for it: 'A' 35: 'C' 19: *AM*. 42, 1, 4 'in a

mill of *AD.BAR* thou shalt draw (?) (*aḤAR. AD.BAR tašaddad*). What the phrase in the letter *ABL. 1049, 4* (*150 epirtu ša aAD.BAR*) means I do not know. (For a gypsum mill see No. 18 (b).)

Finally must be considered with these 'calcining', 'powder', and 'mill', the special '*gaṣṣu* (*IM.PAR*, plaster of Paris) of '*AD.BAR*'. *AM. 77, 5, 15*, a prescription for *šipir mišitti* (bruise or wound), mentions *IM.PAR ša lib aAD.BAR* . . . 'plaster from the middle of *AD.BAR*', and *KAR. 186, 39* prescribes *IM.PAR ša lib AD.BAR* with kelp (?) (*KA.A.AB.BA*) and *aLAL* (some red dye?) against the Hand of Ishtar, *ext.* How can basalt result in *gaṣṣu*?

As the problem needed the help of a geologist I asked Professor Sollas, D.Sc., his opinion, and he most kindly took much trouble to see if the theory that basalt could be calcined into powder could be maintained. He was of opinion that basalt could not be converted into powder by calcining, since, when heated to a sufficiently high temperature, it fuses; but, in order to be certain, he placed a fragment of typical fine-grained basalt in a platinum crucible and heated it in the flame of a Herepath blowpipe to a bright cherry-red heat. The effect was, as he had expected, nil.

With Professor Sollas' excellent experiment before us we must turn to the other equivalence '*ELTEG* 'alkali-stone', which would at first sight appear to be remote from basalt. But I think the following explanation will throw light not only on this, but also on the equivalence 'basalt':

Frequently in Mesopotamia I used to notice in the bazars not only the raw *š'nan*, the alkali collected by the Arabs from the *Salsola kali* or similar alkali-plants (which has rather the appearance of a very fine chopped vermicelli, about an inch long, when exposed for sale), but also sacks of a peculiar grey substance, rather like pumice, which I was told, was calcined *š'nan*. But, as I did not take full notes of it, I wrote out to my friend Major Wilson, D.S.O., Administrative Inspector at Mosul, to ask for the facts, which he most kindly gave me, not only most fully, but even sending me specimens of the calcined substance. This is in irregular lumps, light in weight, and roughly about the content of the ordinary lump of sugar (as we have it in England): the substance, obviously calcined, is of a light grey colour, friable, and easily broken, very similar to pumice (but of course not so solid or hard), and porous: and it may be said that those to whom I have shown it have, at first sight, assumed that it was pumice or lava. I quote Major Wilson's description:

'With regard to *sh'nan*. I send you herewith a sample. The Assyrians [i.e. the modern Assyrians] call it *ikhla*.

'The other substance [i.e. the calcined lumps] is called *qilu* or *jilu* by the Arabs, and by the Assyrians *qila*. It is produced from the

sh'nan by a process of burning. . . . They are employed 2 parts *sh'nan* to 1 part *qilu*. The former is crushed to powder, and with the latter wrapped in a thin muslin cloth, and the whole placed in boiling water for a few minutes. A foam is thus produced, cold water is added, and clothing, &c., washed in it. It is reputed that by this method grease, &c., are readily removed.'

Here, then, at all events, is an explanation for the equation **ELTEG* = *aban uḫuli* = *adbarum*. The Assyrian geologist made a comparison between the appearance of the burnt alkali, obviously a calcined product, and the burnt appearance of, let us say, lava, possibly even with pumice. As 'basalt is distinguished from lava by its content of water' (*EC.* 293) and pumice is 'porous, spongy, volcanic scoria', and in particular, at Bitlis the lava 'is generally a light friable porous rock, but in some places becomes also compact and augitic, passing into basalt' (*Tr.* ii, 369), there is nothing at first sight against the view that **AD. BAR* can cover basalt, lava and pumice. Of pumice, *HD.* 410 says: 'As to Physick, the little Use made of it [pumice] is not worth speaking of, save only that after Calcination and powdering, it makes a Denti-frice for the cleaning of the Teeth'. Lemery (*ib.*) says that it is 'alkaline, detersive, drying, us'd for old Ulcers, sore Eyes, and to clean Teeth'. Pliny speaks of pumice calcined three times for poultices and eyes (*NH.* xxxvi, 42). Pliny's 'calcining three times' seems very near our Assyrian 'four' and 'seven calcinings' and Pomet's description in *HD.* of pumice. I may say that I have tested a piece of ordinary household pumice in a flame, and it powders easily thereafter into a white powder similar to plaster of Paris in appearance. Black lava is abundant at Diarbekr, and this, doubtless, is described by the Assyrian **šalamtu* 'black stone' (see also **šū*, No. 99).

To sum up: **adbaru*, the 'black stone' (**šalamtu*) is basalt, from the lions at Arslan Tash. It can, however, mean 'lava' or, at all events, 'pumice', which was calcined several times before powdering in use in *MT*. Its synonym **ELTEG* 'alkali-stone' is used as a picturesque parallel from the result of calcining alkali, which is similar to pumice in appearance.

21 (f) **Kašurrû*, **KA(v. GA).ŠUR.RA*, basalt.

Meissner (*OLZ.* 1922, 244, quoting *BS.* 45; cf. *Luck.*, *Senn.*, 127) showed that this was basalt: *Senn.* describes **kašurrû* as being from a distant mountain, and used beneath his doorposts (i.e. as sockets, such as are usually found of basalt). The mythical description in Geller, *AOTU.* i, 4, 296, mentions it with **šū* (whetstone) and compares them to wild bulls, &c., and a smith is apparently connected with them. Langdon (*BE.* xxxi, No. 8, 7 ff.) **GA.ŠUR.RA.ZI...GIŠ.BAL.A ḪAR.GIM.MA* shows that a drill for cutting is in question, but it is

not entirely clear whether this refers to it or to the ^aMAŠ.ID (II. 3, 6), ^aDUB.BA.AN (I. 4), or ^aukittum (II. 4, 7), which precede it. It is more probable that the ^aGA.ŠUR.RA represents the basalt cut by one or more of the others into statues.

^aKašurrū, as basalt, is similar to the root *kašāru* in *aban kašari* 'pumice' (= ^ašū, No. 99) and the Kashiari mountain.

21 (g) ^aUŠŪ, ^aESI, diorite, dolerite.

'A' 33 (see D. 1322, 37, but not always to be referred to this stone): Scheil, *RA*. 1918, 115, 12. Amiaud showed that this was the name of the dolerite (diorite)¹ of Gudea's statues from Magan (*ZK*. 1884, 249: see De Morgan *MMAP*. i, 24, 121 and *ISA*. 105, 16, a, iii, 1). Curiously ^aušū and ^ašū (properly pumice) are confused once (*Bab. Misc.*, 7), and a mortar of white marble is perhaps called by this name (Meissner, *A7SL*. 1931, 154 quoting a text, Hilprecht, *BE*. i, No. 33) but, I confess, I am not sure of the reading.

Ušā (sic) and ivory (*šinni*) were used in late Bab. times for building (*NK*. 139, 11), following certain woods, and there is no determinative whether it is a wood or a stone. In the mythical text (Geller, *AOTU*. i, 4, 281, 25) it occurs with ^asū (whetstone), ^aSAG.KAL, ^aUZ, and ^aKA.GI.NA (haematite), and (*ib.* 300, 19-22) it is addressed 'thou [bendest?] strong copper like leather', and it is considered proper for royal inscriptions and statues (*ib.* 25-8).

Dolerite occurs in the Baarem Hills, the Mountains of Masius (A, 19: cf. 266): 70 miles E. of Damghan (Mactear, *TIM*. iii, 1894, 22). It was used in Egypt for maceheads, &c. (*AEMI*. 359).

21 (h) ^aAšnan, ^aAN.ŠE.TIR (^aŠE.TIR, ŠI.TIR?), garnet (?), the matrix containing garnets (?).

Used as material for colossi by Esarh., *PE*. 26, 15: by Senn., *Luck.*, *Senn.*, 127, d, 2, the latter king making an *askuppu* ('threshold slab', *ib.* 133, 80) and a pavement (*kigallum*) of it (including red breccia and *sābu*-stone, *ib.* 83). But Sennacherib shows that it was also a jewel-stone; *ša kima šeim šahhari šikinšu nussuku* 'whereof the choice composition is like *šahhari*-corn' (*l.c.*), in the time of his fathers so precious as to be used only for necklaces (*l.c.*, and 132, 72) the latter passage comparing it to *zēr kiššē* 'cucumber seeds', and describing it as a *ḫabē*-stone (amulet?) to bring favour and confidence, that sickness approach not to a man, and that it came particularly from the Nipur Mountains, i.e. the Judi Dagħ near Jezirah. It is worn as an amulet against *mišitti* (bruises, or sim.), the other three being *ḪUL.GIG*, *SAG.KAL*, and

¹ 'Diorite is the name of a family of crystalline, granular rocks, consisting essentially of feldspar (white) and hornblende (black or dark green)' (*AEMI*. 359) while dolerite is 'merely a coarse-grained basalt' (*ib.* 361).

AŠ. GĪ. GĪ (arsenic) (*KAR.* 213, 3, 6), and three beads of it are threaded on a twisted thread of blue and white for *SA. GAL. LA* ('swollen muscle'), *CT.* xxiii, 9, 11: cf. 6, 18.

Now its name 'divine corn' suggests a small jewel of this shape, and yet at the same time we have to see in it a mass of stone large enough for colossi, coming from the Judi Dagħ. I doubt whether Geller's 'conglomerate of many small stones' (*AOTU.* i, 348) or Meissner's 'Fusolinkalk' (*AOTU.* ii, 57: *Bab.-Ass.* i, 350) fit the idea of jewels, and I suggest that it is the 'feldspatho-pyroxenic' rock ('chiefly basalt and augite rock') which is found near the foot of the Judi Dagħ, cited by *A.* 266, and in the plain of Jezirah near (267). These rocks here are not definitely said to contain garnets, but about 150 miles W., at a point 6 miles N. of Eidlebazar, the feldspatho-pyroxenic rocks 'form a band . . . abounding in garnets and titaniferous iron' (*ib.* 262), and there should be no reason why the formation should not be the same continued at Jezirah. The very name garnet is supposed to be either from *granaticus* (comparing the colour and seed of the pomegranate) or from *granum*, 'cochineal' (lit. a grain).¹

Although Beck says that garnets are not common among ancient Mesopotamian beads, and Hayes Ward that they are not used for cylinders (*SC.* 6), Handcock (*Mes. Arch.*, 267), mentions one in a silver ring of the Assyrian period in the British Museum of uncertain date. They were used in Egypt as beads in predynastic times (*AEMI.* 344), much used by the Romans for engraved gems (*EB.* 11th ed., xi, 470), and common ('orientalischer Granat') among the Sassanians (Horn und Steindorff, *Sassanid. Siegelst.*, v).

It may perhaps be written without *AN*: 3 *ŠE. TIR* are mentioned in a lapidary's list, *KAVI.*, 185, iv, 7, and 1 *²KIŠIB ŠI. TIR ħuraši* (*TA.* 25, ii, 30). (See footnote to No. 9 (a) and (b).)

¹ Garnets are widely distributed in crystalline schists, gneiss, granite, metamorphic limestone, serpentine, and occasionally in volcanic rocks (*EB.*, *ibid.*).

22-105. VARIOUS MINERALS

22. ^alā-pa (sic, re-exd.).

Used in *MT.* for retention of *KU.GIG* (probably constipation), *AM.* 40, 5, 20. Uncertain: cf. ^aPA, ^aiartu, No. 23.

23 (a) ^aIartu, aiartu, iaeri, ^aPA, 'white coral (?)'

23 (b) ^aPA ša 7 GÜN^{pl} -ša 'white coral (?) with seven branches'.

23 (a) The equivalence ^aPA = ^aia'ertu was shown by Langdon (*JSOR* iii, 39) from the duplicates of the Descent of Ishtar where in iv *R.* 31, r. 32 ^aPA^{pl} is replaced by *ia-e-ri-te* in *KAR.* 1, r. 27. The same variation occurs in ll. 36 and 31 respectively (it is not easy to see what the true meaning of the passages is). He also adduces two passages from omens (Boissier, *DA.* 217, 7 and *CT.* xxviii, 44, 13) where the similarity is so great that the ^aPA stone of the one may well be the *a-a-ar-ti* of the other. To these add another variant from *KAR.* 194, 47, ^aia-dr-tū ša 7 GÜN-ša for the more common ^aPA ša 7 GÜN^{pl} -ša (šu). Langdon, on the ground that *PA* = 'branch', and a comparison with *Aram.* yôh^arâ, perhaps 'coral', considered ^aiartu as coral.

^aPA, ^aiartu, occurs, *BBR.* 11, r. iii, 9, to be strung and worn. In *MT.*, for *urinary trouble*, drink with many others, *AM.* 58, 4, 7: drink one šu with others for *stone*, *AM.* 4, 4, 7, dup. 30, 12, ii, 2 (?): to stay *menses*, bray and put in vagina on wool, *KAR.* 194, 46: put on man's middle (pubes), *AM.* 52, 6, 9. Against *demon*, *KAR.* 184, 13: cf. *AM.* 88, 4, r. 8, ^aPA ša 7 GÜN^{pl} -ša: against *poison*, *ext.*, (*šimmati*), *K.* 3274, 10: for *bruise* (?), *ext.*, *KAR.* 192, iv, 30. In *jewellery*: '5 ^aPA', *ADD.*, No. 993, ii, 10 (re-exd.). (The occurrence in *Gudea H.* 6 (*ISA.* 131) for 'diorite' must be a mistake, since *KAL* is the sign in the parallel passages, as Thureau-Dangin points out.)

In the Legend of Ishtar Ereshkigal sends Namtar to free Ishtar and he goes to E. Galgina, where the threshold is of ^aPA^{pl}, and thence he brings out the Anunnaki. In *BBR.* 11, r. iii, 7 ff. ^aAN.GUG.ME (red) is used with red wool, while ^ašubû (black) and ^aPA are strung on a doubled (?) cord. If we can infer anything from the colour ^aPA should be white by contrast. If so, it should be white (and not red) coral, which will still allow us to see red coral in ^abaḫrê.¹ Pliny (*NH.* xxxii, 11) says that coral is found in the Persian Gulf (where it is known as 'iace', perhaps a corruption of ^aiartu), the reddest and most branchy being most valued, and in India it is regarded as an amulet, branches

¹ Langdon would see *corallium rubrum*, depending with due reason on the Targum on Lam. iv, 7, where *p'nînim* 'red) coral' ('they were more red in body than *p'nînim*') is explained by 'they were more red than *yôk'rîn*'.

being hung on babes. If calcined and drunk, it relieves griping pains in the bowels, and the bladder, and is used for stone and for eyes. But Mr. Beck tells me that coral is very rare in Mesopotamian finds.

The following instance in Assyrian magic is curious, and, as a ritual for favour in the eyes of princes, has perhaps a far-reaching interest. The ritual prescribed runs (*KAR.* 238: Ebeling, *MDAG.* v, 3, 43): *ZID.ZID erī ZID.ZID *iaeri ZID.ZID parzilli ana libbi šaman būri tanadi (di) šepēⁱⁱ-šu ana libbi [tašakan] [šepēⁱⁱ-šu?] taptašaš^{pl} -ma ana pāni rubī irrub;* 'Thou shalt put powder of copper, powder of *iaeri*-stone, powder of iron, into *būri*-oil, [thou shalt put] his feet therein, rub [his feet?] therewith, and he shall enter into the presence of the prince'.

Here, just as in the love-charms with magnetic iron ore and iron filings (see No. 8 (g)), we have doubtless substances which represent sympathetic attraction. Naturally the first substance which would suggest itself would be amber, the rubbing on the feet being intended to represent the electric effect, and the powder of copper and iron the necessary particles which fly to it. Actually Pliny (*NH.* xxxvii, 13) says of the lyncurium (perhaps amber, or even tourmaline, which has the same property, Bostock, *Pliny*, vi, 405) that it attracts to itself not only leaves and straws, but thin plates of copper and even iron, which is a curious parallel to our text. Of course, there is no possibility of **iaeri* being amber here, but there are certain substances other than amber with the same attractive power, and I may say that I tested a piece of coral and found that both iron and copper filings would adhere to it after friction. This principle of attraction as representing love and friendship may perhaps lead to the identifying of amber in cuneiform (see, e.g. **abarummu*, No. 26).

23 (b) *PA ša 7 GÜN^(p) -ša (šu).

To be worn on neck, *AM.* 46, 1, 26: for *šimmatu* 'poison' *AM.* 91, 1, 2: for hair falling out ('tie knots'), i.e. as amulet, *AM.* 3, 2, 16: for some trouble in menstruating, to be bound on the woman's 'middle' (*pubes*), *KAR.* 194, 47: to be bound on temples with many others, *AM.* 102, 23: for when a man's eyes roll (*KAR.* 213, 2, 13). It may perhaps vary with **PA*, No. 23 (a). *GÜN* here must be referred to the roots *hipū* 'broken', *nakāsu* 'to cut off', *salātu* 'to cut up', &c., referring to the division or branches ('white coral of seven branches, divisions').

To sum up: **PA* is *iārtu* (which looks like a compound of the old *IA* = stone + *ārtu* (*PA*) 'branch'), with a form **PA* of seven divisions, branches'. As Langdon suggests, it may be *yôhārâ*, the Aram. perhaps for coral. In myths it represents a threshold, and in *MT.* it fairly well corresponds to the classical use. It is worn as an ornament, and as an amulet, perhaps with some reference to its attractive powers after friction.

24 ^aĀB (= lid). BIL, unknown.

CT. xxiii, 50, r. 4, for head (TE being appar. the verb defining the use of this stone). *ĀB.BIL.A.AN*, mentioned *RTC.*, 136, r. ii, 3.

25 ^aIbari, uncertain.

BRP. 13, 40, 'If *tirāni* (viscera) are like *aban ibari*'.

26 ^aAbarummu or ^aabašmu, unknown.

There is little whereby this mineral may be identified. It is worn: in virility(or love)-charm, on neck, *LZ.* 30, 41 (*KAR.* 70, 41): as one of nine for 'favour of Bêl', *KAR.* 213, 4: one of ten, to free a man from sorcery, on neck, *AM.* 7, 1, 5: worn, *ib.* 29, 2, 8: one of several, folded in red cloth and bound on, *KAR.* 192, iv, 31. In what are presumably jewellers' lists, *K.* 1278, (3 ^aaba-aš-mu): *K.* 4212, (dup. *Rm.* 320) (^aa-ba-aš-me): *S.* 914 (v *R.* 30), r. 4, (2 ^aaba-aš-mu): *ADD.* 993, i, 10 (re-exd.) (1 *tag-gaz aba-aš-mu ana 1 abni*). In *TA.* No. 25, ii, 47, as ^aa-pa-aš-mu-ú: *GE.* ix, 29, vi, 29, as ^aaba-aš-mu, with ^asāsu (red lead), ^aianibu (green vitriol, black) ^aKA . . . (haematite or iron ochre, red) and ^aMUḤ.ĀŠ.GE₄.GE₄ (arsenious acid, white). That it is always written with *aš* (= *rum*) is a fair indication that the probable reading is *abarummu*. It might conceivably be offered as a possibility for amber, owing to its use in charms as an 'attractive' substance (see No. 23 (a)).

27. ^aUZ, unknown.

Geller, *AOTU.* i, 4, 281, 23-26, *ina birišunu kima rīme rabē karnāsu ittanāšši* ^asū ^aSAG.KAL ^aušū ^aUZ šadānu (^aKA.GI.NA) *karrađu* ^aGIŠ.ŠIR.GAL *karrađušunu alāni išallalšunuti* 'amongst them like a great wild ox he lifted up his horn: whetstone, *SAG.KAL*, diorite, *UZ*, haematite; the hero despoiled the cities of their hero alabaster'.

28 ^aUkittu (?), unknown.

Perhaps read ^aurutum (Geller, *AOTU.*, i, 310, 4-5, 7, 13).

29 ^aElū (?), ^aNA, unknown.

^aDitto (= ^aNA) *ša ana taḥazi-ia iška ta . . .* Geller, *AOTU.* i, 4, 301, 41.

30 ^aAlgamišu, ^aUD+ŠAL+KAB, ^aKÛ.BAL.E, ^aĀŠMUR, corundum, emery, amethyst.

I am indebted to the courtesy of the Royal Asiatic Society for permission to quote in full from my article in *JRAS.* 1934, 344.

^aAlgamišu I compared with the Arab. *jms̄t* 'amethyst' (as preferable to the Heb. *algābīš* 'hail', of Hommel, *Sum. Les.*, 123, n. 1), *OTC.* 36.

^aKÛ.BAL.E, i.e. 'bright+spindle (drill)' indicates the use of a

lapidary's drill, Amethyst (i.e. the Oriental amethyst) is a form of corundum, and this latter in general is used for cutting gems (*EC.* 487: *PC.* viii, 1837, 66: cf. *SC.* 9: *MGI.* 55). This is paralleled by another form of corundum, *šipru*, sapphire, described as *a^akunuku* 'the seal stone' (i.e. 'for cutting seals'), *šipru* meaning literally the 'scratching thing' (No. 15 (b)).¹

The next indication comes from *KAR.* 213, 2, 11 (dup. *AM.* 46, 1, 24):

Kaḫkad ⁽ⁱ⁾*pilakki GIŠ.MIŠ kaḫkad* ⁽ⁱ⁾*pilakki UD+ŠAL+KAB* (*algamiš*) *ŠE GIŠ.MIŠ ŠE* ^(a)*UD+ŠAL+KAB* (*algamiš*) ^(a)*ĀŠ* (v. *ĀŠ*). *GÌ. GÌ* ^(a)*KA. GÌG* ^[(a)]*PA ša 7 GÛN^{pl} -ša* (v. *šu*) ^(a)*šû GIRA* (*u*) *ŠAL* (*aZALAG*) *10 abnê^{pl} Enuma NA ênâte^{pl} -šu iššanundu^{pl} (du).* 'A head of a spindle of *GIŠ.MIŠ*, a head of a spindle (drill) of *algamiš*, a grain of *GIŠ.MIŠ*, a grain of *algamiš*, *ašgigi*-arsenic, black iron oxide, coral (?) of seven divisions, male and female pumice, (lime), ten (!) minerals for When a man's eyes roll (?).'

GIŠ.MIŠ, *Celtis Australis*, L. (Meissner, *MVAG.* 1913, 2, 20). Wooden spindles are sold for spinning wool in the bazars at Mosul.² I do not know of what kind of wood they are made, but Gillet and Marne (*Flore Française*, 1898, 438) say that the *Celtis Australis* is used by basket-makers. The ritual introduces these objects, which have a rotatory movement, as sympathetic magic to stop the eyes rolling. It may be that pumice represents either grit which impedes the revolution, or that it is the smoothing stone which removes friction by its polishing, while the yellow and black represent the colours of the eye.

In Scheil's text, *RA.* 1918, 115, we find:

20. *aUD+ŠAL+KAB = al-ga-[miš]*
21. *aSAG UD+ŠAL+KAB = kaḫ-ka-du* ,,
22. *aBUR UD+ŠAL+KAB = bur-ru* ,,
23. *aUL UD+ŠAL+KAB = di-ka-ri* ,,
24. *aŠAKAN UD+ŠAL+KAB = šik-ka-tum* ,,

L. 21 'head of corundum, amethyst' is the head of the drill described above. The others appear to be objects made of amethyst. L. 21 is paralleled in the lapidary's list *KAVI.* 185, iv, 12, 'two *a^algamiš*' (13) 'one *SAG.BAL* (head of drill), ditto'. Emery powder (?) appears to occur in the middle of the Third Millennium: 1 *aKIL.ŠE al-ga-miš* 'one powder (?) of corundum' (*TE.* No. 6055, r. iii, 10). (*KIL* occurs also in front of the difficult word *ŠE+BAR+ŠE* 'barley' (*CT.* xxiii, 45, 9), but here again, *KIL* (= *šibirtu*) is uncertain.) 'Two *a^algamiš*' occurs *ib.* 6044, r. v, 12.

As the diamond was not known to the Assyrians it is not impossible

¹ Hayes Ward (*SC.* 9) dates the use of the bow-drill and emery (corundum) in Babylonia first by seals of the Kassite style.

² *GIŠ.ŠAG.BAL*, wooden head of a spindle, goes back to the Epoch of Ur, Scheil, *RA.* 1921, 67, 7. What is the *a^aGIŠ.MIŠ* of *AM.* 102, 34?

that in *algamiš* we have the origin of the Greek *ΑΔΑΜΑΣ*. Theophrastus (185), speaks of a stone from Armenia used for cutting others. Ahmed Teifaschi, *De Gemmis*, 44 (ed. Ravius) says of *al-jmst* 'Amethysti species prope Medinam obvia', and mentions *al-zanbadj* 'lapis quo poliuntur adamantes'. (For the important equivalent ^a*AŠ.MUR*, see No. 4 (u).)

31 ^aUI (?) -la-nu-um, unknown.

Geller, *AOTU*, i, 4, 314, 22.

32 (^aĒni imitti), ^aIGI.ZAG.GÁ, 'right eye stone'.

That this is a true stone is clear from K. 2409, ii, 18 ff. dup. of *KAR*. 213, iv, 5 ff.: ^aZA.GÌN ^aPAR.AŠ ^aKA.SIG₇ ^a? (19) ^aGUG. Marḥaši ^aAN.KAL ^aabarummu (20) ^aIGI.ZAG.GÁ ^aTUR.MI.NA (21) ^aTUR.MI.NA.BANDA ^aŠIM.BI.ZI.DA (22) ^aašpú ^aMUŠ. GIR ^aka-nu-[u] (23) ^adušú Marḥaši. In *KAR*. 213 its place is taken by (^a) *IGI.LAG.GÁ*,¹ and ^aka-nu-[u] by (^a) *za-ka-nu*. Also in Col. i, 9 (of K. 2409), and *ADD*. 993, ii, 1 (re-exd.) 'one *IGI.ZAG.GÁ* (no break)'. Otherwise it might have been thought from *ABL*. 847, r. 2 that it is a stone for the right eye (in a statue): . . . *PAR.AŠ* (?) 3 *ubani ruṣša-ša tág-gaz ša* ^a*IGI.ZAG.GÁ* . . . 'alabaster (?)', of three fingers wide, worked stone (?) of *IGI.ZAG.GÁ*.

33 ^aĒni iṣṣur(i), aban ḫilli (v. ḫilla), ^aIGI.ḪU.NA 'bird's eye stone'.

'B' 15: 'F' 8. Very rare. On the analogy of *pitti* (*pitú₄*), *ḫillu* might be akin to the Aram. *ḫel' á* 'sling', so that *aban ḫilli* would be 'sling-stone'. But *tarmanu* also means sling-stone (p. 111), and is not given as equivalent to *aban ḫilli* in the dictionaries. (For ^aĒni nūni see No. 81.)

34 ^aEN.GI.ŠÁG, ^aBAR.GÛN.GÛN.(NU), unknown.

'H' 37: 'J' 72. *BAR.GÛN.GÛN.NU.KUR.RA* = *atar ili* 'chameleon'² (*Br*. 1886), which should indicate a stone which can change

¹ See No. 80, where another variation with ^a*IGI.LAG.GÁ* is suggested.

² In regard to my identification of the chameleon with *atar ili* (*PRSM*. 1924, 17), I must, in spite of Landsberger's view (*Abh. d. Sächs. Akad. d. Wiss., Phil.-Hist. Kl.*, xlii, 104) that it is 'Bergigel' (mountain hedgehog), maintain my translation. Professor Landsberger's work is characterized not only by great care, but by a generous courtesy to my views, and I am loth to go counter to what he has put forward. I think, however, that my evidence for chameleon (which Professor Landsberger has been so good as to quote in full) is still sufficiently convincing. In *PRSM*. 1924, 17, part of the *atar ili* (= Syr. *wárálá*, lizard) is used in a charm to turn grey hair black, a very natural process with the aid of a chameleon in sympathetic magic. Its synonym *ḫarbabilu* (or *ḫarbabibilu*) I compared to the Arabic *ḫirbá*, a chameleon. Landsberger (*l.c.*, 104) draws attention to the similarity of its Sumerian value (*BAR.GÛN.GÛN.NU* (= *ḫarbabulum*) and *BAR.GÛN.GÛN.NU.KUR.RA* (*a-a-ar ili*) (*ib.* 16, ll. 205-6)) to *ŠAḪ.BAR.GÛN.NU* 'porcupine' (l. 163) 'Schwein mit mehrfarbigem

its colour in the sun, suggesting dichroism. Not a drug: brought by Esarh. 'from the mountains' for his palace (Cyl. A, v, 21), but the minerals with which it is associated (*aparātu* (marble), *ašnan* (garnet?), **TUR.MI.NA* (uncertain), **TUR.MI.NA.BANDA* (breccia), **alal-du(!)* (limestone), **GI.RIM.ŠĀR.GUB.BA* (large spherical pyrites)), give no indication whether it is for decoration or more practical purposes. In *KAR.* 213, ii, 22, against 'anything evil', and *ib.* 24 against *bennu* (epilepsy?), and in 3, 14, 'for anything evil, the Hand of a Bull': a form **GAR.GI.ŠĀG* occurs (probably a mistake) (*CT.* vi, 11, ii, 19): 'One **EN.GI.ŠĀG*' occurs in the lapidary's list, v *R.* 30, 67, g, and 'One: one ditto (*Br.* 7335) *EN.GI.ŠĀG* for three (stones)' (re-exd.), *ADD.* 993, i, 13, 14, while l. 15 (**HAR* ditto) suggests that it can be a ring-stone. It is in the same line in *AOTU.* i, 4, 314, 21 (Geller) as *ašnan* (matrix of garnet?). Also in *Shurpu*, viii, 69.

What the connexion of this stone is with the mountain of *šadū* *BAR.GÛN.GÛN.NU*, whence came *AN.NA* (tin, see No. 13), is difficult to say.

35 Aban ^{11a}Anim, 'Stone of Anu'.

One of thirty-four against 'anything evil, Hand of Bull', *KAR.* 213, iii, 15.

36 *Ennakki, *LAL.SIG₇ (?), unknown.

Zimolong, *Sum.-Ass. Vok.*, i, 31.

37 *UR, unknown.

With **ašpu*, **šāḫḫū*, **AN.KAL*, **šadānu šabitu*, and male copper, to be pierced and worn, to turn troublesome dreams to good (*KAR.* 252, r. 4, cf. 213, i, 30). Mentioned with silver and gold (*K.* 3010, ii, 4): in lapidary's list, *ADD.* 993, ii, 8, 'one *tāg-gaz* of **UR* for one' (an abbreviation from i, 1, 'one seal of **ŠĀ.U.Ū* (stone) *ana 4 abnē^{pl} HAR* (cut to four stones?)). In *CT.* vi, 11, ii, 40 after **BIL*: in *UMBS.* xii, No. 14, 4 (Langdon), a Sumerian list of stones, between **ŠI* and **BIL*.

38 *Ur-ri-ga, AM. 88, 2, 15. See footnote to No. 4 (g).

39 *Ašpû, *aspû, *iašpû (no Sumerian), jasper.

Long identified with Heb. *iāš'pneh*. 'Greenness and more or less trans-Balg' (i.e. its black and white quills). But the word *BAR.GÛN.GÛN.NU* is obviously distinct from *ŠAḤ.BAR.GÛN.NU*, which is thus defined as a pig, a definition not given to the former. Moreover, *ḥarbabilu* and *aiar ili* in the vocabulary are separated from the 'porcupine' by more than forty lines, while they immediately precede the lizards (I admit, with a division line between). I cannot think, therefore, that the *aiar ili* has anything to do with a porcupine. Finally, Professor Landsberger objects to my comparison of *aiar ili* with the Syr. *wārālā*, on account of the Arabic *waran* which he would compare to *urnu* (*ib.* 45) 'yellow (green) snake'. But, as he himself recognizes, the Varanidae are lizards, not snakes. There is another *aiar ili* (Landsberger, *op. cit.*, 140).

lucency were the two essential characteristics of the ancient Jaspis' (PSG. 202). Pliny says jaspis is green and often transparent and that of Persia especially is sky-blue, whence its name (*aerizusa*) (NH. xxxvii, 37): throughout all the East 'it is the custom, it is said, to wear iaspis by way of amulet' (*ib.*). King (PSG. 206) maintains that 'the Jaspis of the ancients was our Calcedony (Silica and Alumina): in its primary sense the variety coloured green by nickel, now called Plasma, but in after times embracing the blue, the purple, the yellow, and whitish-brown shades of the same substance'.

This colour is not necessarily confirmed by the Assyrian, which seems to show in a mythological text that ^aašpū is red. This is the text describing the heavens symbolically as a furnace, with the ^aašpū of the lower heaven representing the fire (see No. 7 (f)-(h)).

Tushratta sent a *šumbiru* of ^aiašpu to Am. III, probably the Syr. *šmbrā*, a lunate ornament (TA. No. 22, iv, 6). Sargon, who calls Zimur (Zihār) the mountains of ^aašpē (somewhere in the neighbourhood of Van or Urartu, HC. 145), laid his foundations with *musarrū*-tablets of gold, silver, *uḫnū* (lapis), ^aašpē, *aparītu* (marble), *erēb* ('copper'), AN.NA, iron and A.BĀR (lead) (Gde. Inscr., 159), and this proximity of blue lapis and white (?) marble suggests a red for the jasper. Asb. adorned the statue of the Moon-god with a seal of ^aašpū, according to Nabonidus (Messerschmidt, MVAG., i, 38, 32: cf. Streck, *Asb.*, 170 n.¹), and used silver, gold, copper and ^aašpī for his gates (K. 2668, Bauer, *Das Inschriftenwerk Assurbanipals*, ii, 76, 12). As a prophylactic bead, one of nine 'for the favour of Bēl', KAR. 213, 4: to wear on neck, AM. 7, 1, 6 (^aašpū *šal-la*): and curiously, lime and ZID. ZID (powder of) ^aašpū, ext. against 'Hand of Ishtar', KAR. 186, 40: thread and wear, to turn troublesome dreams to good, ^aašpū, ^asaḫḫū, ^aUR, ^alamassu, ^ašadānu *šabitu*, ^aURUDU GIRA (male copper), KAR. 252, r. 4, 5 (cf. KAR. 213, 1, 30). Apparently the first hard stone to be used in Babylonia was jasper (so SC. 7), and red- or rose-jasper is quoted as a material for Assyrian seals (Delaporte, *Cat. Nos.* 309, 357, 363, 378, 380). In lapidaries' lists: 3 ^aašpū, v R. 30, 60, i: 1 (not 2) (re-exd.) ^aašpū, ADD. 993, 'iv' (prop. 'iii'), 9: one *tāg-gaz ašpū* [*sic*] (*ib.* i, 7).

40 ^aAšakki, or aban ašakki ('stone of ašakku-disease', calculus?)

In the 'Chemist's Vade-mecum' texts, CT. xiv, 10, i, 5: 44, i-ii, 16, 17: Meek, RA. 1920, 181, S. 1701, i-ii, 8: Mat. 88, i, 43: *puḫuttu(m) ina ašakki (ašakku)* 'thistle in (on) stone of ašakki'.¹ Although Pliny (NH. xxii, 44), quoting Erasistratus, says that the white *sonchus* carries off calculi, there is no other evidence as yet that the *aban ašakki* can be considered as calculus, but it may be.

¹ In CT. xiv, 44, 17 the additional line indicates that some drug other than *puḫuttu* (lost) is used for *ašakki*.

41 *Išmi(k)ku, unknown.

TA. No. 22, ii, 65, mentions a *huliam* of this, from Tushratta to Am. III: *ib.*, 25, ii, 22, a *šugur* of it, from T. to Am. IV. (A foreign word?)

42 *Bidanam or *bidnam, unknown.

A white stone mentioned by Ikunum (c. 2000 B.C.) (IAK. 20, No. 2, 7 and p. xvii).

43 *Baḫrê, *ḪAR.ḪU(M).BA.ŠIR, coral (muzaltu 'sphere').

'A' 28: 'H' 6: 'J' 54. In order to make [*ba*]ḫ-ri-e, a minute proportion of go[ld] is included in a glass melt, which must thus result in the Assyrian form of the Purple of Cassius (see Introduction). Since the ruby, as far as we know, was unknown to the Assyrians, *baḫrê* must mean some substance other than ruby, but having a red colour (OTC., 35). Boson (*It.* 416) had, I think, recognized that the form *baḫrê* was peculiar among all those words ending in -u in the syllabaries, and compared the Arab. *baḫrî* 'of the sea', and so 'pearl'. I would suggest rather 'red coral' (in contrast to *iaeri, No. 23), which will give us the red substance to take the place of ruby.

*ḪAR.ḪUM.BA.ŠIR must have some definite similarity with the plant *ḪAR.ḪUM.BA.ŠIR (AH. 272), for which parallels are thus given: **tibuti eḫli arḫitu* 'yellow signet of the field', **ib-ni mûti* (or **IB.NI.BAD*) (possibly 'it made + death') 'in the common speech': **mesir UR.BAR.RA* 'wolf-bond': **šami zimete* 'drug for . . .?': **šammi KA.GIG.GA.GE* 'drug for toothache': **NU.BU* (in all these instances the right hand column is missing, but they are all in one register, *ḪAR.ḪUM.BA.ŠIR being one of them): confirmed by a group of four in a similar syllabary copied by Herr Pick, from which, by the courtesy of Prof. Ehelolf through Prof. Langdon, I am enabled to quote: *ḪAR.ḪUM.BA.ŠIR, **šamu misir libbi* ('drug for binding the heart, mind'), **šamu KA.GIG.GE* ('drug for toothache'), all equated with **šamu rapadi* ('drug for *rapadu*')¹, and **NU.BU* as 'drug for *rapadu* in Shubari'. **Timbutti eḫli arḫitu* occurs CT. xiv. 41, K. 8829, 12, but the other drugs in the same register are not sufficiently close in meaning to warrant our counting them as certain equivalences: in CT. xiv. 10, viii-vii, 11, dup. Mat. 88, iii, 34, **tibu(t)ti eḫli arḫitu*² = *mārat iḫ Ištar* 'daughter of Ishtar'. In MT. it is prescribed: **tibuti eḫli* (without *arḫitu*) = *šammi* ditto (i.e. *KU.GIG.GA.GE*, sick anus), dry, bray, mix with fat, apply, KAR. 202, iv, 11: KAR. 186, r. 43 (without *arḫitu*), bind on, against AN.TA.ŠUB(?): uncertain (without *arḫitu*),

¹ *Rapadu* with its meaning 'run about' as a verb, and as a disease, its parallelism with *šaššatu*, *maškadu*, *bennu*, in groups in which *SA* 'muscle' forms the base, suggests some muscular lack of control, *bennu* being supposed to be epilepsy.

² *TAR(GÜN)* in Mat. Undoubtedly animal here (Landsberger, *op. cit.*, 125).

AM. 64, 2, 8. Similarly, ^uHAR.ḤUM.BA.ŠIR ext. on *scorpion-sting*, AM. 91, 1, r. 5: bind on, for *pain* caused by ghost, AM. 70, 2, 15 (dup. KAR. 182, r. 28): anoint, AM. 92, 4, 10: bind on, for *swelling*, KAR. 192, ii, 15: bind on *head*, KAR. 202, ii, 47: drink alone for *stomachic* trouble produced by heat (in the same way as **ammi* and 'poppy fruit', presumably each alone in the same text (AM. 48, 1, 9+78, 3, 6)): apparently to drink when loins hurt (kidneys?), AM. 31, 1, 7 (+59, 1: *Babyloniaca*, xiv, 1934, 15): one of 37 drugs to drink for urinary trouble (KAR. 193, 7).

In this plant ^uHAR.ḤUM.BA.ŠIR, parallel to ^uti(m)buti ekli arkitu, 'yellow signet(-ring) of the fields' we have the following characteristics: used ext. against pain, esp. teeth: less commonly drunk for urinary and perhaps kidney trouble: if *rapadu* means some form of seizure or loss of muscle-control, we may have in it a drug causing or used for a stroke, mania, or similar: *misir libbi* suggests a restriction of the mental faculties.

In OTC. I suggested the *Withania somnifera*, one of the solanaceae, of which the dried red berries had been given me by a Mosul priest for fumigating aching teeth (Hooker, *Flora of Brit. India*, iv, 239), in Arabic *merjân* 'coral' (Post, *Flora*, 568): possibly the common *Hyoscyamus niger*, L., henbane, has some of the characteristics: it has a yellow flower, it grows wild in W. Asia, it is a powerful narcotic poison producing delirium in medicine, it has been used from early times to produce sleep and allay pains, and in later times it has been used for epilepsy, mania, and cerebral excitement (VK. 550 ff. p. 649). In p. 644 the leaves are used to allay irritability of the bladder, and to prevent griping in visceral neurosis. Smoke from the seeds taken into the mouth through a tube was a favourite remedy for toothache in the Middle Ages (Henslow, *Poisonous Plants*, 127). Some such identification would seem to be certain: in the latter case the seed capsule is peculiarly embedded in the persistent calyx (ib. 126: picture, VK. pl. xxxvi) which, if ^utimbuti ekli were also a plant (improbable), might suggest the comparison of *timbuti* with a hemispherical gem-stone in a ring. This could hardly apply in the case of the berries of the *Withania*.

The essential part now, as far as the ^uHAR.ḤUM.BA.ŠIR stone is concerned, will be the seeds or berries. In this case the red berries of the *Withania* coincide well; the brown seeds of the henbane (about one millimetre broad, 'hell graubraun oder gelblich', Luessen, *Medicin. Pharmac. Botanik*, ii, 986), are less satisfactory, but still plausible.

^aBaḥrē occurs in lapidaries' lists: '2 baḥrē' both in ADD. 993, 'iv', 7 (re-exd.) and KAVI. 185, 11. For *šunni e-* . . . , KAR. 213, iv, 2: cf. Langdon, BE. xxxi, 62.¹ The curious equivalent *muš(s)altu*, which appears to have been slipped in as an afterthought, must surely be the

¹ ^aBa- . . . AM. 69, 12, 3, 4.

Syr. *mauzalthâ*, sphaera, referring to the coral beads which appear to have been spherical in shape even in the time of Pliny who compares them to the red berries of the cultivated cornel (*NH.* xxxii, 11), and to this day in China large spheres of good coloured coral command high prices (*EB.* 11th ed., vii, 131). Pliny (*ib.*) says that red coral came from the Persian Gulf, and John Stevenson (*Med. Zool.*, 235) that it is found in the Indian and Mediterranean seas. In ancient Egypt there is only one instance of white coral (a large quantity at Defenneh, seventh to sixth century B.C., in the form of natural branches), but the two red kinds, the 'solid, branching kind' and the lesser known 'pipe' coral (in the form of hollow tubes) are common, the latter going back to predynastic times, the former of late date (*AEMI.* 342).

We may thus accept that **bahrê*, 'the stone of the sea' and **ĦAR. ĦUM.BA.ŠIR* 'the *Withania* (?) -stone' (with synonym *muzaltu* 'spherical'), used as the simile for glass coloured with the purple of Cassius, is coral: and that the plant **ĦAR. ĦUM.BA.ŠIR* is probably the *Withania somnifera*, *L.*

44 (a) *BI.LA, unknown.

'Y' 10 (an omen text), following **AD.BAR.*

44 (b) *BIL.LI, or aban billi, unknown.

LZ. 30, 42 (*KAR.* 70, 42) to be worn.

45 *Burallu, beryl.

Meissner points out that beryl originally came from India, as its Skr. *vāidūriya* shows (*Ass.-Bab.* 1, 351). Pliny (*NH.* xxxvii, 55) says 'according to Democritus there is also a stone called *belus*, found at Arbela; it is about the size of a walnut and looks like glass'. *Belus* certainly is near enough to the sound of *billūrīn*, beryl, of *Esth.* ii, 1, 2, (*Targ.*), the Arab. *bellur* 'glass', the variant of *bērūlīn* (*Dalman, Ar.-Neuh. Wörterb.*, 62). An early cylinder of beryl is mentioned (*Speleers, Cat. d. Int.*, No. 596, p. 179), and *SC.* 8 mentions one bluish beryl, although saying (p. 6), that the beryl is not known as a cylinder. *ABL.* 570, r. 10, speaks of the boiling of **burallu* (on the dyeing of gems, see *Introd.*).

The zircon, when reddish brown, may be completely discoloured by heat (when it may be sold as a diamond, *WM.* 131), and it is possible that we may see here the origin of the Arab. *bellur* 'glass' from *burallu*.

Beryl is found in the Dumbu Dagħ, near the Divrigi River, NW. of Assyria (*A.*, 285), and in the Red Sea hills of Egypt (*AEM.* 160).

46 Barraḳtu, emerald (?).

U[nḵ]u ša tamlû-ša barraḳtum 'a ring whereof the setting is *barraḳtu*' (*Hilprecht-Clay, BE.* ix, 41, 3, date Artaxerxes). Borrowed? Heb. *bārēḳēth*, Syr. *bār'ḳā*, supposed to be emerald.

47 ^aBuršašil[a], ^aBUR.ŠU.ŠAL.LA, unknown.

'H' 17: 'J' 68. Apparently paradoxically occurring (^aBUR.ŠU.ŠAL.LA) in a list of what must be stone vessels all beginning with ^aBUR (Schileico, *ZA*. 1914, 293), equated with ŠU-u.

48 ^aGI.DUB-tâmtim ('GI.DUB of the sea') unknown.

AM. 66, 7, 2, dup. *KAR*. 193, 9, to drink with many others for urinary trouble. Cf. ^amisis tâmtim, also for urinary trouble.

49 ^aGAR.KALAG.GA, unknown.

Doubtful. Gloss, prescribed for [sick] temple-muscle, *AM*. 19, 1, 5. Cf. *GAR.KALAG.GA* = *erû* 'copper', *CT*. xii, 36, 45, b, &c.

50 ^aDâme, ^aMUD, see Tâbat amanim, No. 1 (d).

51 ^aDUB.BA.AN, unknown.

Geller, *AOTU*. i, 4, 310, 4, 6: 311, 12.

52 ^aDUR.KIB (?), unknown.

One of seven for 'joy', *KAR*. 213, iv, 14.

53 ^aDušu, ^aDU₈.ŠI.A, crystal¹, glass.

DU₈ = *naṭālu* 'glance', and *ŠI(IGI)* = *ēnu* 'eye', from the flash of the mineral. It is one of the six stones for seal-cylinders (No. 8 (b)-(f)), and also a form of glass, made of 20 mana of sand, 60 mana of alkali, 2 mana of saltpetre, 10 shekels of lime, 1 mana of *tuskû* (cadmia), and 6 shekels of *lulû* (pompolyx) (Appendix I, Sect. T).² Thence, as a seal-stone, it will be quartz-crystal (see also *OTC*. 84), a material used for seals in Gudea's time (*SC*. 7). It was found in the mountain *šadû*. . . *GAB.A* (ii *R*. 51, i-ii, 13), and the Hittite texts say that it came from Ilamda (*KTb*. iv, 1: *KUB*. ii, 2: *KS*. iv, 80, 37).

In a lapidary's list, *ADD*. 993, 3, '1 ^aDU₈.ŠI.A'; and in *RA*. 1920, 212 (Scheil) one ^aDU₈.ŠI.A is mounted in gold for the lady Amat-Ninlil (period of Shulgi). There is a long list of objects made from it (Scheil, *RA*. 1918, 116, 28 ff.): ll. 36-7 show ^aUD.ŠAR DU₈.ŠI.A: *uškari* (crescent of crystal) and ^aAŠ.ME DU₈.ŠI.A: „*šanšu* (sun of crystal), i.e. the moon and sun made of this material. The latter occurs also in *ZA*. 1915, 87 (Schroeder) in a gift of great sun-disks (*AŠ.ME.GAL.GAL*) to the Sun (Cf. Poebel, *BE*., vi, 2, 106 [*AŠ.ME.AŠ.AŠ.A* ^aDU₈.ŠI.A.GE]). *Am*. IV sends Tushratta 1 (*kukubu*) *ša rēši ŠAG.DU ša tušē* (*TA*. 14, iii, 69). Used as a comparison in sky-omens: 'When a star *ana* ^aDU₈.ŠI.A. *utir namarâtum ina mâti ibāššû*¹ ('turns to crystal there will be rejoicings in the land') (ii *R*. 49, 56, a).

¹ *D*., 167, 107, 'e. kostbarer Stein'. Scheil (*RA*. 1918, 120) 'ne serait-il pas une agate chalcédoine?' The form *tušē* occurs, *TA*. 14, iii, 69.

² Virolleaud, *Bab*. iii, 221 (1910), *émail*(?).

SU.DU₈.ŠI.A 'skin of glass' would appear to be sandiver or glass scum, not in the glass-texts, but used as a simile for the urine of a sick man: 'if urine is like *SU.DU₈.ŠI.A*' (*AM.* 58, 4, 4). In *Bab.* 1934 (xiv), 138, I suggested a comparison with the oxalate of lime appearing in urine 'recognized by the white, hummocky appearance of the top of the mucous cloud in the urine' (Lauder-Brunton, in *DM.* ii, 1715). Sandiver is the 'saline scum which rises to the surface of molten glass during the process of manufacture' (*EC.* 866). (For *a²dušū Marḥaši* and *a²dušū Paraši* see No. 9 (e) (1).)

54 *a²Zalaḫu*, unknown.

With others for urinary trouble, Lutz, *AḫSL.* xxxvi, 82, l. 83 (hardly *a²ZALAG*, lime) No. 18 (c).

55 *a²Zaḫanu*, unknown.

For the *na-am* of Sin, *KAR.* 213, iv, 7, where it varies with *a²ka-nu-[u]* on a duplicate (see No. 32).

56 *a²Zuḫaḫipu*, *a²GIR.TAB*, 'scorpion stone'.

'F' 11. Hardly Pliny's *scorpitis* (*NH.* xxxvii, 73), since it is not used particularly against scorpions: used against *ṭihū*-disease and pestilences, *KAR.* 213, iii, 21: against *muṣṣu ṭi*, *ib.* 22: for *ŠE.GA.ŠE.GA* (favour), *ib.* iv, 24. In late lapidary's list with 1 (?) *abarummu*-stone, 1 *KA*-stone, 3 jasper, 1 *sahḫū*-stone (*CBB.* 40, E, 2).

57 *a²Ḫalpū*, ice (?).

To be brayed alone in *ḫimetu*-ghee for eyes, *AM.* 16, 3, 10.

58 *a²Ḫaltu*, *a²DÜ.ŠUB.BA*, *aban šikkati*, probably alum-stone, alunite.

'C' 7, restored from *CT.* xiv, 16, K. 6003, 8 (... *BA* = „(i.e. *aban*) *ṭa-ab-ti šik-k[a-ti]*) shows *a²DÜ.ŠUB.BA* = [*šik*]-*ka-ti*² = *ḫal-tum*. The addition of *ṭābti* to *šikkati* shows that Zimmern was probably right in comparing *šikkatu* to Syr. *škā* 'alum' (*Shurpu*, 60: vii, 90): *kima būri šikkati* (*SAGAN*) *limtissi* 'like a vessel of alum may he be clean' (paralleled by *būri ḫimeti*, 'a vessel of *ḫimetu*-ghee'). The reference is probably to the Roch alum, which was at one period produced at Edessa,³ one of the most ancient manufactories (Rochha being the Turkish name in the Middle Ages for the government which included Edessa), *HD.* 382 describing the Roch alum or 'glass alum' as being as clear and

¹ In spite of the well known (*SU*)*taḫ(?)*-*ši-a*(e), used for the skins of rafts (*AKA.* 74, 57; *NB.* 119: cf. 155), and for dyeing (*ADD.* iv, 360). Tushratta sends to Egypt one pair of *taḫ(?)*-*ši-a* (-leather) slippers, ornamented with gold and *a²ḡargub[ba]* (pyrites). (*TA.* 22, ii, 23.)

² Confirmed from Zimolong, *Das Sum.-Ass. Vok.*, 13, i, 6, *DÜ* = *šikkatu*.

³ Quoted from *PC.* i, 405, quoting Niebuhr, *Reisebeschreibung*, ii, 409.

transparent as crystal (cf. also Berthollet, *Art of Dyeing*, 216). ^a*Ḥaltu* was brought by TP. I (viii, 11) with ^a*KA* (iron ochre) and ^a*KA.GI.NA* (haematite) from Nairi, the lands to the N. or NW of Assyria, which coincides well enough with Edessa to suggest that the manufacture of alum may have been carried on at that city even as far back as 1100 B.C., although unfortunately the ancient name is as yet unknown (*Dûru* being the nearest known city, some 21 km. E. of it, Forrer, *Das Provinz.*, 22).

It is used as a solid stone in rituals: seals were made of it (Thureau-Dangin, *RA.* 1921, 167, 2: *AM.* 66, 4, i, 7): '3 ^a*ḥaltum*' on a lapidary's list (K. 1278, 4): used against divine anger (*KAR.* 213, 16): against *tiḫ*-disease and pestilences (*ib.* iii, 20): threaded and worn on a woman's 'middle' (pelvis) for menstruation (*KAR.* 194, 4): one of several to be worn on the middle of the uterus for much fluid in the uterus, after the woman has eaten 'hostile' (*ṣirûte*) drugs (*ib.* r. 39). As a drug it is poured on the anus, after boiling with various drugs (many vegetable) in oil and beer (*AM.* 56, 1, r. 6).

We do not find *šikkatu* equated with *gabû*, the alum of the tanners, and, since its equivalent ^a*ḥaltu* is used for seals, &c., it may be regarded as a solid stone. There would, therefore, be every probability that it is alum-stone, or alunite, from which alum is manufactured.¹ The use of ^a*ḥaltu* in seal-making is supported by the existence of cylinders in the middle and late periods made of slaty stone (*SC.* 8). ^a*Ḥaltu* has a superficial resemblance to *ḥaltu* (nutshell?, *RA.* 1929, 58, the Syr. *ḥelthâ*, sheath): as meaning 'alum', possibly some connexion might be assumed with Syr. *ḥallâ* 'vinegar' on account of its bitterness, but the form is against this: or perhaps the Syr. *ḥâlâ* 'sand' (if the meaning might be extended to shale): or perhaps the Syr. *ḥulḥâlâ*, fissura, from the nature of the mineral. The use of *šikkatu* as a drug in *MT.*, presuming that *šikkatu* represents alum-stone, is explained by the fact that the alum can be dissolved out of it by water, after gently heating (*EC.* 131).

The most amusing detail is from *BRP.* iv, pl. 37, 21: *JRAS.* 1924, 456, a quotation from a Babylonian specialist's vocabulary and hand-list, (actually in the line preceding some detail about ^a*gabû*, alum): *šikkat: pa'anu ša am-riḫḫi šimdi ša ŠE.BAR u kaš ŠAR ešteniš(niš) ŠAR.ŠAR-ma: 'šikkat* (alum): a *bonbon* of the confectioner, a delicacy of corn and roses mixed together'. *Pa'anu*, not connected with *pû*, mouth, as I thought, (*ib.* 'bonne-bouche'), but Syr. *pî*, pulcher fuit, *pâyâ*, decorus: ^{am}*RIK* is properly *bappîru*, usually taken to mean 'brewer', but if *riḫḫu* is the Heb. *reḥaḥ*, ^{am}*RIK* may well be the 'apothecary', *rôḳeḥ*, of the OT.² *šimdi* is for *šimti*, 'decoration', &c. (not *šimdi* 'preparation', as

¹ Apart from the source of alum at Edessa, alunite is found at Wadi-el-Guwar, a tributary of the Dead Sea (F.-M. Abel, *Géogr. de la Palestine*, 200).

² But see Landsberger, *AO.* 1935, 150.

I thought). This sweetmeat must surely be the 'saccharine alum' of Lemery (*HD.* 382) ('because it resembles Sugar'), which 'is made of Glass Alum, Rose Water, and Whites of Eggs boil'd together 'till it is stiff; and this Alum so boil'd and reduc'd to a Paste, what Figure or Form you please may be given to it, and when it is cold, it becomes as hard as a Stone', while Pommet (*ib.* 381) says that this 'Sugar Alum' is 'made of Roch Alum, Whites of Eggs and Rose Water boil'd together, to the Consistence of a Paste, and form'd while hot, into little Cakes, like Sugar Cakes'. Although the Assyrians did not use white of egg, as far as we know, doubtless the starch of the *ŠE.BAR*, the roses and the alum would amply represent Pommet's sweetmeat Sugar Alum.

59 ^aHU.LAḪ.ḪA, see No. 4 (*u*).

60 ^aHina, unknown.

TA. 14, iii, 62.

61 (*a*) ^aHusiḡu (perhaps ^ašamḡu): perhaps ^agusiḡu: Amazon-stone (?).

61 (*b*) ^aKasī ŠAR, ^akasī, ^aSILA.ŠAR 'rose-stone', the same as ^aGUG.SILA.ŠAR, 'rose-red stone': lepidolite.

61 (*c*) ^aŠÁ.U.U (abnu šá ešrâ 'stone of twenty'), talc (?).

All these three minerals appear to have the property of protecting those who wear them from stones or chambers falling by chance.

If a man wears the ^ahusiḡu, abnu ḫaiatu cannot come near him (*KAR.* 185, *r.* ii, 11). Similar protection is afforded by ^asû (whetstone), ^aŠÁ.U.U, and ^aGUG.SILA.ŠAR, against *nimeḡu ḫaiattu*. (*KAR.* 213, ii, 25.) For this word *ḫaiat(t)u*, (from *ḫādu*), cf. *KAR.* 205, *r.* 14, and 213, ii, 25, *nimeḡi ḫaiat(t)u*: *KAR.* 233, *r.* 8 . . . -*danu-šu ḫaiattu*: *mukil riš limutti(t)*: and 234, 20, *dini EŠ.BAR šurši gilitum lû rabišu limnu lû ḫaiattum*. *KAR.* 267, 1-2 *enuma NA utukku LU-su ina SU il-ta-za(?)* . . . *u ḫaiatti utukki TUK^{pl}*: *ib.* 5, *šalam utukki ḫaiatti teppu(š)*; *ib.* 6, *šalam utukki ḫaiaddi*: *ib.* 8, *Šiptu: ilu Šamaš annû šalam ḫaiatti 3-šu tušadbab-šu*: *KAR.* 357, 30, 41, *ḫaiadam*. The witch is called *ḫaiditum ša ribâti*, and *muttalliktu ša suḡâti* (*Maqlû*, iii, 4, and 1). The explanation for the witch is usually 'roaming', 'wandering': perhaps the demons are of the same description, 'wandering' or 'chance'. If we compare this idea of 'wandering' with that contained in the Heb. *ābhad* 'wander, perish', a similar meaning for the adjective with 'stone' and 'chamber' suggests itself, that of 'falling' or 'ruined', and, accepting this, we may attempt to build up a theory from sympathetic magic. ^aSû, the whetstone, which is the only stone as yet identified of these four, is an excellent example of lamellar structure, being of mica-schist (No. 83), which is a slaty rock of quartz and mica (*Concise Oxford*

Dict., 719), and this quality suggests that sympathetically the stone which is so easily cleavable, either by its non-cleaving, or by a curious parallel with the idea of the scapegoat inherent in the cleavage, will protect the man from 'rocks which cleave, stones which fall, or chambers which crash in'.

On this supposition we can examine the evidence for ^ahusigu, described (*KAR.* 185, r. ii, 11) 'this is a stone like a green leek, its spots (*tikpu*) . . ., and *šadi rīšu* (cf. l. 9): of this stone its name is ^ahusigu: *abnu ha-ia'-tu* cannot come near the man'. The comparison with a leek coincides with the Amazon-stone both in colour and lamellar structure. This was used in the Kassite period (*SC.* 8), and was evidently much valued for its green colour. Hayes Ward (*l.c.*) thinks that this was either Pliny's Tanos or his Eumithres, the former being described as coming from Persia and of an unsightly green (*NH.* xxxvii, 19), and the latter 'called by the Assyrians "gem of Belus", of a leek-green colour, and greatly in request for superstitious purposes' (*ib.* 58). Less probably talc, also of a lamellar structure, and apple green (*WM.* 243).

(^aHusigu might perhaps be the same as ^agusigu, *ABL.* 340, 5 'about the ^agusigu stone, about which I sent unto the king, &c.')

Similarly consider ^aSILA.ŠAR (^akasī ŠAR) ('C' 12: 'F' 13). Since it has the addition in its other form of *GUG* 'red', it coincides well with *AH.* 83, where I tried to show that *kasī ŠAR* was 'rose' and not 'cassia'. Cassia-stone is impossible. The form 'rose-red stone' occurs as far back apparently as the middle of the Third Millennium in the form '1 ^aGUG.SILA' (*TE.* 6055, r. iii, 10): and later as a seal (^aKIŠIB ^aGUG.SILA.ŠAR, *K.* 4212, r. 3, dup. *Rm.* 320, 2 (mutilated)). and 1 ^aKIŠIB ditto (= *GUG SILA ŠAR*) (text re-exd.), *ADD.* 993, ii, 4 (a *tāg-gaz* of it occurs on l. 2). ^aGUG.SILA.ŠAR is to be worn against sorcery (sprinkled with cedar blood) with four others (*AM.* 89, i, ii, 13), and it occurs along with ^asū 'whetstone' and ^aŠĀ.U.U, for *nimedi haia(t)tu* (*KAR.* 213, ii, 25: cf. 205, r. 14). ^aSILA.ŠAR is used for good luck and plenty with eight others, *ib.* iv, 15.

If we take this as rose-coloured quartz, used for cylinder-seals (rather late, *SC.* 8), or rose-cornelian (Ménant, *Glypt. Or.*, 64, Assyri.) similarly used also for seals, we must relinquish the idea that ^akasī is a lamellar stone. On the other hand, lepidolite is a lamellar possibility; 'of a characteristic lilac or peach-blossom colour. . . as compact scaly masses', and used for making small ornamental boxes (*WM.* 238). At present the evidence is not certain enough.

But, still continuing with the lamellar possibility, we can now go on with ^aŠĀ.U.U. The reading *abnu šā ešra* 'stone of twenty', is based on the plants *šammu šā U+U* and *šā U+U+U ŠAR* (*AH.* 201), and our present mineral *abnu šā U+U*.¹ The fact that the *U+U* is frequently

¹ *CT.* vi, 12, 9, b. ^ašd+[u?]+u.

written close up in this word so as to be the sign *MAN* indicates that '20' must be intended. Probably those who wrote *U+U* recognized the difficulty, and saw to it that the reading 'ten+ten' was secured. It is possible that the *abnu eš-ru-u* of *Nbn.* 267 is evidence for this.

Šā *U+U+U. ŠAR*, šā šelašā *ŠAR*, 'plant of thirty' = *bišru* 'onion'. Possibly this has reference to the numerous skins of its bulb (cf. the Arab. *sab'a w' sab'in* 'seven and seventy' for the centipede). In that case we ought to see a parallel in our *abnu šā ešrā*, which should be easily cleavable geologically into 'skins' or 'leaves'. In *MT.* *abnu šammu šā ešrā* is drunk (?) (one *šu*) for stone in kidney (?), *AM.* 30, 12, 3: drink for some urinary trouble, *AM.* 58, 4, 8: *KAR.* 193, 8; note in all these the form *abnu šammu šā ešrā* 'stone+drug of 20', the same form occurring without *abnu* (conforming to this tablet in particular) on *KAR.* 213, 6 (in the same text, ii, 25, *šā ešrā* is also used, 'for favour of Ea'). Certain drugs, kneaded in *himetu*-ghee and **ša ešrā*, to be applied to the 'skin of the eyes', *AM.* 9, 1, 36, suggest a mineral easily used in combination with fat, for it is most unusual for any mineral to be described in this way. Talc is certainly greasy, and as one of the softest minerals is easily scraped. As a medicine it is used as a soothing and protecting powder to the skin (*P.* 1192). For **ŠĀ.U.U* as a seal cf. No. 37.

62 *Hu-si-ri(?) -ša (*šam-ri(?) -ša), unknown.

With others on wool to stay menses, *KAR.* 195, 45.

63 Husaru, unknown.

Lewy (*Kultepet. Frida Hahn*, 18), 'ein Mineral (oder den Bernstein?)', quotes *KTS.* 22, b, 3 ff., 6 *manē husaram abnam lagaḫam kunukia Uzua našakum* ('6 minen *husārum*, einen klotzigen Stein, (mit) meinen Siegeln (versehen) bringt die Uzua'), and *CCT.* iv, 40^a, 24 ff. *ana šumi *sāmtim u husarim ša tašpurani* (see his remarks *l.c.*).

64 *Harnanu, *ḫaršananu, unknown.

Both of Babylon, *CT.* ii, 1, a, 2, 2 and 6, 2.

65 *Kak-ku-us, *kak-ku-sa, *kak-ku-sa(k)-ku, probably pounded chalk.

The similarity of two other forms to one another, *IM.MA.AN.NA* and *immanakku* 'sand', allow us to assume the identity of the two forms **kakkus* and **kakkusakku*. They have all the appearance of a foreign word, just as *immanakku* suggests ἀμμοκόβια. This present mineral occurs frequently alongside **šū* 'pumice' in *MT.*: male **šū* and **kak-ku-us* alone, *KAR.* 185, ii, 5, probably (from l. 6) to be used for the muscle of the heel: **šū* and **kak-ku-sa-[ku?]*, threaded on the sinew of the heel of a gazelle, to be worn for *šimmatu* 'poison', *AM.* 91, 3, 8: **kak-ku-sak-ku* and male and female **šū* occur in the same prescription for some form

of bruise, probably ext., *KAR.* 192, iv, 30, 32: and also **kak-ku-[sak-ku]* with **sāndu*, &c., for the muscle of the heel, *AM.* 70, 5, 5. In the lapidary's list *K.* 1278 four **kak-ku-sa-ku* are mentioned, and *TA.* 13, 12 gives . . . *kakkusu *uknū u *m[us . . .]*.

Its association with **šū*, the stone used in smoothing vellum, suggests another stone also used for vellum. Without actual medicinal value (like the **šū* 'pumice'), it may have the sympathetic idea of smoothing the diseased or rubbed skin. In making parchment 'when the skin is divested of its hair or wool, it is placed for some time in a lime-pit, and then stretched on a square wooden frame drawn tight by pegs. When in the frame, it is first scraped on the flesh side with a blunt iron, then wetted with a moist rag, covered with pounded chalk, and rubbed well with pumice-stone; after a short pause these operations are repeated, but without chalk; the skin is then turned and scraped on the hair side once only; the flesh side must now be scraped once more and again rubbed over with chalk, which must be brushed off with a piece of lamb-skin retaining the wool' (*PC.* xvii, 1840, 243).

The Syr. *kōkāšā*, terra mollis (if it be not properly for the Arab. *mumāšā*, Brockelmann, *Lex.* 157), certainly would bear this out. On the other hand, the use of this stone by Assyrian lapidaries, &c., has to be explained, and I can only suggest that, if it be chalk, or whatever the Assyrians may have used in place of this in preparing skins, its magical value was important enough for it to be used in a similar manner to pumice.

The fact that Pergamus was supposed to have been the home of the invention of parchment almost suggests that the words *calx* and *kakkus*¹ may have been borrowed in the making of parchment from the intermediate country between the West and Assyria, in the same way that *immanakku* suggests the borrowing of ἀμμοκονία.

66 ^a. . . KISIM.PA.UD.DU, unknown.

CT. xxiii, 37, 10+*AM.* 2, 1, 9, in a group of eight on a red and white thread, to bind on temples, when a man's head *ittenibaššum* (smells offensively?).

67 ^aKISIM.ŠAR.A, unknown.

In a group of nine, for a position in the palace, *KAR.* 213, iv, 10: in a group of nine, for plenty and increase, *ib.* 15.

68 ^aKapašu, more rarely, ^akabašu, a red stone.²

To be worn: *AM.* 17, 3, 7: on neck, against sorcery, *AM.* 7, 1, 7:

¹ *Kak-ku-us* might, at a pinch, even be read *kal-ku-us*, but it is improbable.

² We may omit the possibility of restoring 'J' 71, **bissir tâni [sic] = aban kaba- . . .* to meet this stone, as the medical value of **kabašu* does not coincide at all with **biššur atani*, which is particularly used for urinary troubles.

in girdle, *KAR.* 238, r. 6 (Ebeling, *MDAG.* v, 3, 41, 6), to find favour with a prince: threaded and worn: temples, *AM.* 102, 23: on 'black'¹ wool, on hand of child, *LK.* 32, r. 16: on pubes of woman with trouble in menstruating (probably excess), *KAR.* 194, 5: ritual, K. 4727. Put with others on a pledget of wool into the vagina for menorrhagia, *KAR.* 194, 45. Against an angry god, *KAR.* 213, 18. There is one doubtful passage in which it is prescribed to be brayed and drunk for menorrhagia, **GUG* **ka-pa-ša*, as a gloss to **GUG.KA*, *šurranu*, perhaps a form of flint (here out of the question, *KAR.* 194, 40).

The long ritual iv R. 55 [62], 1, 15 ff. (where **ZA.SUH*, white vitriol, is put on a white thread, **KA.GIG*, black oxide of iron, on a black thread, **ka-pa-ša* on a red thread, and **AN.BAR*, iron, on a blue thread), shows that this stone is probably red in colour.² In a lapidary's list '2 **kabaşu*' are quoted ('total 26 *ša-tam(par)-tim*', *KAVI.* 185, v, 10, 13).

Cf. **ka-pa-aš duš* = *ka-pa-šum*, and **tag-gaz ukn* = [**k*]a-pa-ša [*ukn*?(?)] (Scheil, *RA.* 1918, 116, 46, and 117, 91 (*TU.* No. 36)).

69 **Ku-saḥ-ḥi-li* (?), unknown.

LZ. 13.

70 **Lamassu*,² **GAR.ŠĀG.GA*, **AN.KAL*, agalmatolite.

'H' 3: 'J' 55: *CT.* xiv, 17, K. 13697, 4. Jeremias (*ZA.* 1886, 46) pointed out that the seal of Urzana, king of Mušasir in Sargon's reign, made of this stone, was actually of agalmatolite: 'a soft species of mineral . . . used by the Chinese for carving' (*EB.* 11th ed., i, 363). (*HC.* xii, n. 3, 'jaspe rose'). In *MT.*, to free a man from a tabu, with others ('water of *AN.KAL*') (*Shurpu*, viii, 69): for *ḥuṣ GAZ libbi*, as a solitary mineral with plants, *KAR.* 186, 15; for when a man's god or goddess is angry, *KAR.* 213, 17 (cf. iv, 6): uncertain, *AM.* 7, 1, r. iv, 7: in a group, K. 2409, ii, 19 (unpub.): to turn troublesome dreams to good, *KAR.* 252, r. 4: 213, 30: on neck of child, against evil, *LK.* 32, r. 9.

71 **Me-ku*, unknown.

KAR. 213, iv, 5, *ana na-am iḥSin*. Variant on K. 2409 perhaps **me-ku*, perhaps **ḥUL*.

72 **Multaspu* (?), **ŠAL.LA*, unknown.

'H' 18, *mul-ta-as-*. . . : 'J' 69, *mul-tu(tas?)*-p[u(?)]. In Agum's inscr. **ŠAL.LA* adorns Marduk's shrine (v R. 33, ii, 41). Always as amulet

¹ Text sim. to *AM.* 17, 3 which supports the '3 **ênâte*^{pi} 3 **paré*' of iv R. 55 (l. 18) and **AN.BAR* on blue (l. 21). Presumably the text is correct, but it is in curious contrast to iv R. 55.

² Is this the same word as the Arab. *šanam*, 'idol'?

or sim. in *MT.*: for when a man shivers in bed, (*ŠAL.LA*), *KAR.* 213, 2, 28: for *šimmat* (poison) of the right hand (^a*mul-tas-. . .*) Langdon, *BE.* xxxi, 62, 26: uncertain (^a*ŠAL.LA*), *AM.* 29, 4, r. 6. In a lapidary's list, *ADD.* 993, ii, 9 '2 ^a*ŠAL.LA*'.

73 ^aMu-nim (?), unknown.

KAR. 213, 22, to appease an angry god.

74 (^aMenišuti), uncertain.

See Agum's inscr., v *R.* 33, iii, 6 (p. 144).

75 ^aMisisu, unknown.

KAR. 193, 9, bray and drink with others for urinary trouble. ^a*Misis tâmtim*, *AM.* 58, 4, 9, the same. Cf. ^a*GI.DUB.tâmtim*, also for urinary trouble (No. 48).

76 Aban marti, ^aŠI, 'stone of bitterness' (or 'gall-stone').

'A' 2: 'G' 17: Langdon, *UMBS.* xii, 14, 4. Uncertain: perhaps bitter-spar, so called from the presence of magnesia.

77 ^aMarḥallum, unknown.

Distinct from *marḥaši* in ^a*GUG.Marḥaši*, &c., when in compounds. ^a*GUG.Marḥaši* and ^a*GUG.marḥallum* appear to occur on the same text (Scheil, *RA.* 1918, 118 (*TU.* No. 36), see 97 and 99). ^a*Marḥallu* on *TA.* 25, ii, 49: cf. ^a*mar-ḥa-lim* (or *ši?*), *ib.*, i, 52 (see No. 9 (e) (1)). A seal made of it, *K.* 4212, 6: and a *kuninu*, *TA.* 22, ii, 67: threaded and worn, *BBR.* 11, r. 28: to secure a position in the palace, *KAR.* 213, iv, 11.

78 ^aMAŠ.ID, unknown.

Geller, *AOTU*, i, 4, 310, 3, 6: 311, 11.

79 ^aMussirrum, unknown.

TA. No. 13, frequently.

80 Aban nûni, ^aHA, ^aIGI.LAG.GÁ, 'fish-stone' (a blue stone?).

'B' 17: 'C' 8: 'F' 4. *KAR.* 213, i, 8, 'crystal', (^a)*IGI.LAG.GÁ*, green vitriol, serpentine, and (^a)*AN.BAR* (iron, of blue colour, see ^a*kaṣaṣu*, No. 68) 'five minerals for the favour of Adad', apparently ranging (in order?) from crystal through green to blue, because of their relation to the Weather god, so that we might see in ^a*IGI.LAG.GÁ* a stone of pale blue colour. Indeed, if *IGI.LAG.GÁ* be translated 'gift-eye', we might see in it the blue of blue eyes which the Arab of Mosul (if of nowhere else) regards as outstandingly beautiful among so many brown eyes.

Also *ib.* iii, 15, one of thirty-four against 'all evil, the Hand of a Bull', and *ib.* iv, 6, one of fourteen *ana na-am ilu Sin*, but it must here be noticed that K. 2409, ii, 18 ff., a dup. of *KAR.* 213, iv, 5, gives *^aIGI.ZAG.GÁ*, as variant for *^aIGI.LAG.GÁ*, and almost equally noticeable is K. 2409, i, 9, *^alahhú ^aIGI.ZAG.GÁ* comparable (but not variant) to *KAR.* 213, iii, 3, *lahhú IGI.LAG.GÁ*. *^aIGI.LAG.GÁ*, Langdon, *BE.* xxxi, pl. 50, ii, 13, to be worn, for poison of the right hand.

81 *^aĒni nūni, ^aIGI.ĤA, 'fish's eye' (pearl?).*

See *^aĤA* (No. 80). In an early Sumerian vocabulary (*SLT.* 125, 5), and in a ritual, to be threaded to stop hair from falling out (*CT.* xxiii, 34, 39: *KAR.* 202, ii, 21). One of seven for 'favour of Anu', *KAR.* 213, 3: one of fourteen to turn away the anger of a god, *ib.* 21. Cf. *ib.* ii, 26.

'Fish-eye' is tribute from Dilmun in a tablet found by Woolley at Ur (A. T. Wilson, *Persian Gulf*, 28), for which 'pearl' is suggested. But cf. also Pliny's astrobolos (*NH.* xxxvii, 50) which resembled the eye of a fish (apophyllite, Fischaugenstein, *ichthyophthalme*, *Anc. Min.*, 228).

82 *^aNA.LU.A, uncertain.*

Taken from the Baršib Mountain by Gudea (*ISA.* 111, vi, 60).

83 *^aSû, ^aKALAG.GA, ^aKA.ŠAL.LA, whetstone.*

By the courtesy of the Royal Asiatic Society I am able to quote in full my article in *JRAS.* 1934, 343.

'A' 30, 31: 'H' 1, 2: 'J' 44-7 give the equivalences *^aKALAG.GA = ^a(^{altu})KA.ŠAL.LA = ^asû = aban kisusi*. The first suggestion comes from *^aKALAG.GA = 'the strong (i.e. the hard) stone'*, and the second from *^asû ana ^{ikakkêl}-ia kî ta-at(?) . . .* (Geller, *AOTU.* i, 4, 297, 42: *KAR.* 14, ii, 38-9) 'When thou dost . . . the *sû*-stone to my weapons'.¹

The association of a hard stone with a metal naturally suggests 'whetstone', which is at once borne out by the equivalence *aban kisusi*, which, from the root *k-s-s*, in late Heb. *pilp.* and Aram. *palp.* means 'to rub', will mean the rubbing stone. The word *^asû* will then be comparable to one of three roots, one of which must be assigned to *^asû* 'whetstone' (and another to *^ašû* 'pumice'). These are:

1. Heb. *šûa'*, to polish, Syr. *šâ'*, livit.
2. Arab. *sihâ'*, parchment, from *saḥâ* 'scraped off' (probably = *^ašû* 'pumice').
3. Syr. *ša'* 'polivit, *š'â'dâ*, 'lapis laevis' (probably = *^asû* 'whetstone').

¹ Cf. *ḫarradu ana ^asi-e* (Sumer. *^aSU.Ū*) *^akasurrê izziḫ-ma i[ḫabbi]* 'the hero on the *sû*-stone, basalt, stood to (?) s[peak]' (*AOTU.* i, 296, 36: *KAR.* 33-4). Cf. *1 tåg-gaz si-e* (*ADD.* 993, i, 4, re-exd.) and *ib.* ii, 11; *1 tåg-gaz su-u* (12) *1 ultu lib naši* (13) *riḫtu issuḫar* (cf. *ll.* 17, 18, and *isuḫar*, i, 6, 19).

The Sumerian word ^{a(dlu)}KA.ŠAL.LA might perhaps be translated *os uteri*, the association of rubbing being perhaps the clue. But the variant suggesting that it is the city from which the stone came makes this difficult. Whetstones are frequently found in Babylonian diggings (Mackay, *Jemdet Nasr*, 285: *UE*. ii, 415 ff.). *Am*. IV sends 117 to Burnaburiash (117 ^amašeldu ša ^{am}gallabi, *TA*. 14, iii, 74). Hill in *Theophrastus* (lxxvii), says that the whetstones were of extreme hardness, and first came from Cyprus, but that later the Armenians were found to be much harder, and were adopted. According to *DAP*. iv, 1, the best oilstone is the Turkey oilstone, exported from Smyrna, which contains 70–5 per cent. silica, 20–5 per cent. calcium carbonate, and a little alumina. The coarsest kind of whetstone, the scythe-stone, is a porous fine-grained sandstone, and the next better is a ragstone or mica-schist (*EB*. 11th ed., xiii, 652).

84 ²SAG.GE₄.A.BA, unknown.

Brought by Samsu-iluna from the West (Boson, 28: Poebel, *BE*. vi, 2, 59, r. 7). It measured 1½ *gar*, 4 cubits, 10 inches (?), about 11 metres.

85 ²SAG.KAL, unknown.

Equivalence lost, 'A' 32. In early Sum. list, *SLT*. 125, 6, and Langdon, *UMBS*. xii, No. 14, 12 (?). In Geller, *AOTU*. i, 4, 231, 25, with others, some hard. For two other occurrences, see *²rāme* (No. 96). Tushratta sent it probably to *Am*. IV as part of *maninnu* with 'mountain' lapis and gold (*TA*. No. 25, i, 51), and 'five pomegranates' are made of it (if correctly restored, *ib*. ii, 4).

86 ²Sahhû, unknown.

Used probably on neck, threaded on two-coloured (black and white?) cord ('14 ^asahhê'), *AM*. 47, 3, iii, 21. Against the anger of a god or goddess, *KAR*. 213, i, 17: against the anger of a god, *ib*. 22: to obtain the mercy of a god, *ib*. 25: against *AN.TA.ŠUB*, *ib*. ii, 6: against all evil, *ib*. 18: against all evil, the 'Hand of a Bull', *ib*. iii, 13: in a virility charm (*ŠĀ.ZI.GA*), to be threaded, *KAR*. 70, 42. To be threaded, Langdon, *BE*. xxxi, p. 64, ii, 3: threaded to turn troublesome dreams to good, *KAR*. 252, r. 4, cf. 213, i, 30. In a lapidary's list '1(?) *abarummu*-stone, 1 "scorpion"-stone, 1 *KA* . . .-stone, 3 jasper, 1 *sahhû*-stone' (*CBB*. 40, E, 2): K. 1278 mentions '2 ^asahhû': K. 2409, r. 9, gives it in a group of magical (?) minerals.

87 ²SAK.KI, ²KI.NAM.AN.NA ('KI.NAM of heaven'), lit. 'Stone of the temples'.

From ^aKI.NAM.AN.NA, 'H' 4, it must be the name of a separate mineral, and not a general term 'temple-stone'. In *MT*. ^aSAK.KI

bound on the right temple, *CT.* xxiii, 43, 5: triturated and used in ointment and poultice for temples, *AM.* 102, 31. But cf. *K.* 1278, where after 30 or 40 minerals, varying in number from 1 to 100 (the last being '100 male pumice stones'), a note is given 'let them bring a total of 216 *SAK.KI*-stones (*abnē^{pl}* *SAK.KI^{pl}*)'.

88 *Aban suluppi*, a*KA.LUM.MA*, date-stone.

This would appear to be the actual stone of the date, and not a mineral. *KAVI.* 175 is a 'tonplombe' inscribed a*KA.LUM ša Kardunias* 'date-stone of Karduniash', which certainly does not look like the seal of a consignment of dates, but rather a slinger's joke, it being perhaps a clay 'slingstone'. (The size is not given, nor is there any mention of it having been bored as a seal.)

In *MT. aban suluppi* (date-stone), lime, sulphate of iron, and arsenic, are to be bound on the pubes of a *pregnant woman* against the *lamaštu*-witch (Thureau-Dangin, *RA.* 1921, 164, 4): for *head*, bray with others (ext.) *CT.* xxiii, 50, 16, and 19: uncertain disease, bind on, *AM.* 25, 3, 5: threaded and worn for some affection of the *temples*, *AM.* 104, 25: water (?) of (?) date-stones, for *cough*, &c., uncertain use, *AM.* 27, 2, 16 (*RA.* 1929, 83): *ZID* (powder), 'reduce', bray and apply to *eyes* alone in rose-water, *AM.* 8, 1, 12.

89 a*SU.MUŠ*.(*KU?*), unknown.

TD. 5529, 15 and *r.* 1.

90 a*Pilakku*, a*BAL*, 'spindle-stone', 'drill-stone' (belemnite(?)), see No. 10 (c).

In *K.* 4751, 3, it is described as . . . *abnu* (?) *uš-šu-* *abnu šuātu* a*BAL šum-šu ana ênâte^{pl}* (*hi-bi*) . . . ' . . . it . . . a stone (?), that stone its name is a*pilakku*, for eyes (wanting)', and *ib.* 4, . . . *i-mur* (*har*) *abnu šuātu* a*BAL MU.NI* . . . 'has seen (?)', that stone a*pilakku* is its name'.

Apparently not in syllabaries. In *AM.* 102, 32, three kinds, red, black, and yellow, are prescribed, brayed and used in ointment and poultice, and to be bound on *temples*, against ghostly attack. In *AM.* 8, 1, 33, it is to be brayed alone in saliva and applied to *eyes* full of blood: for *eyes*, *AM.* 12, 4, 4. It stands first in the curious list of drugs in *CT.* xiv, 16, 93084: and occurs in *AM.* 7, 1, iv, 9. It and the yellow kind are in a lapidary's list (one each) (*KAVI.* 185, iv, 9, 10), where, by the additional inclusion of two a*UD*+*ŠAL*+*KAB* (corundum) and one a*SAG.BAL* 'head of drill', it is probable that a*BAL* 'the drill-stone' has nothing to do with emery or corundum.

The word 'drill-stone' from its shape would suggest belemnite, the fossil cephalopod, which in old times was mistaken for a thunderbolt. It was powdered and administered for nightmare, and it was blown into the eyes of horses suffering from watery humours, or used for dressing

wounds (*PC.*, s.v., iv, 1835, 172). Lemery (*HD.* 409) says that they are found of different colours sometimes white, sometimes grey, and sometimes brown, but the medical use he gives (for eliminating calculi), does not coincide, and it is therefore quite uncertain. Moreover, there is a possibility that ^a*bišsur atani*, No. 10 (c), is the belemnite.

91 ^aPulukku, unknown.

BRP. iv, 13, 41 and 42.

92 ^aŠiru, ^aMUŠ, 'serpent-stone'.

'F' 10. In *MT.*; against 'Hand of Ishtar', bind on,¹ *KAR.* 186, 31: threaded, Langdon, *BE.* xxxi, 60, 12. ^aMUŠ.DIR 'red serpent stone', used for the favour of a ruler (?), *AM.* 7, 1, r. 6: for when a man shivers in bed, *KAR.* 213, ii, 28, which also includes ^aMUŠ.PAR 'white serpent stone'. (^a)*IGI.MUŠ* 'serpent's eye stone', used that the *lamassu*-guardian may have a watchful eye (?), *KAR.* 213, iv, 19.

93 (^aŠabitu), ^aMAŠDA (MAŠ.DĀ.E) 'gazelle-stone' (bezoar-stone?).

Only once, as far as I know, in *AM.* 13, 6, 17, where *ḫuršipti ekli* (nettles) are to be brayed in ^aMAŠ.DĀ.E and applied to eyes. What is noticeable here is that the 'stone' is the medium in which the nettles are to be brayed, and there is no mention of fat or oil, so that it looks as if we had some substance, called by courtesy a stone, capable of replacing this latter medium. It is unnecessary to say how greatly valued the bezoar stone is in the East: 'Bezoar is a Stone taken out of the Belly of certain Animals in the *East-Indies*. . . . It is found in Balls of different Sizes and Shapes . . . the Superficies of all of them are smooth, polish'd, shining, of an Olive or grey Colour. Their Substance, when broke, divides like *Laminae*, or Scales. . . . It contains in it some small Matter of volatile Salt, that is sulphurous and oily' (*HD.* 237). The animal from which the Oriental Bezoar is taken is called a *capricerva* (*ib.*). The Arab. is *ḥajar al-bakar* (Dozy. *Supp.*, s.v.).

There is, however, little to recommend the identification of the two in the medical usage which appears, in the case of the bezoar, to be internal.

94 (a) ^aŠiptu,² unknown.

94 (b) ^aZibit, unknown.

Apparently two distinct minerals, from *KAVI.* 185, v, 7-8, '^azibit 6 ^ašipte'.

¹ *AŠ-su*, a common final word in *MT.*, perhaps replaces *LAL-su* (*tašamad-su*) as on *AM.* 22, 2, r. 13, and 29, 1, 7.

² Written *šip* (i.e. *zik*, *Br.* 4686), *CT.* vi, 12, B, i, 32, from which a seal (*KIŠIB*) and staff-handle(?) (*PA*) are made.

*Šiptu: in *MT.* threaded and worn on pubes for menorrhagia, *KAR.* 194, i, 5 (cf. *ib.* 47): probably on pubes, *AM.* 52, 6, 4: on neck for poison, *AM.* 91, i, 2: for 'joy', *KAR.* 213, iv, 14. A special kind from Gutium, *šiptu Gutitu, ext., to stay falling hair, *AM.* 3, 2, 17. The Syr. *šepthā*, *lapis annuli*, does not help us.

*Zibit: in *MT.* hang on neck against sorcery, *AM.* 7, i, 8: one of several, *KAR.* 192, iv, 31. Geller, *AOTU.* i, 4, 314, 19, *ZIB. *TUM.E.*

95 *Kakkadu, *SAG.DU, 'head-stone'.

Langdon, *UMBS.* xii, No. 14, pl. xxi, 11. 'Against anything evil, the Hand of a Bull', *KAR.* 213, iii, 18: bind on temples, *AM.* 102, 21, 31: 105, i, 5.

96 (a) *Râme (aban râme), *KI.ĀG.GÁ, 'love-stone', *MAḤ, *GUG (sându)-silim. (Cf. aban rēmi, *ARRUŠ, 'G' 20.)

96 (b) *La-râme (aban la-râme), *NU.KI.ĀG.GÁ, *ḤUL.GIG, 'hate-stone'. (Cf. aban šalti, *DU₁₄, 'E' 6: 'G' 19.)

'B' 13, 14: 'H' 5.

(a) 'Love-stone', apparently red from *GUG-silim. A stone ('two *ĀG.GÁ') occurs, *ADD.* 993, 'iv' (properly iii), 8, (re-exd.), but whether it is the same or not is doubtful.

Plants *KI.ĀG and *NU.KI.ĀG (*NU.,) occur on *CT.* xvi, 26, K. 4429, dup. (as Meissner pointed out, *MVAG.*, 1904, 29): cf. *ib.* 31, K. 4581.

(b) 'Hate-stone', *KAR.* 213, iii, 6, for *mšitti* a bruise (or sim.) with *ašnan*, (*a*)SAG.KAL and (*a*)ĀŠ.GÌ.GÌ, and *ib.* iv, 12, with (*a*)SAG.KAL and (*a*)ĀŠ.GÌ.GÌ for 'a favourable finger' (cf. my *DES.* i, 29, *ana arki-ia ubanu damiktīm littariš* 'after me may a favourable finger be pointed'). The inclusion of arsenic (*ĀŠ.GÌ.GÌ) suggests either that the use of arsenic in removing tumours ('hangnails, polypi', Pliny, *NH.* xxxiv, 56) was intended to typify the removal of the hatred represented by the 'hate-stone' (thus inducing a 'favourable finger', and the removal of the hostility shown by the *mšitti*-bruise), or, less probably, that the yellow of orpiment traditionally typifies jealousy: but whether we can find a parallel in this to our 'hate-stone' is uncertain. *SAG.KAL is unidentified. The natural identification of the 'hate-stone' would be something that roused a natural disgust, say, for example, *stinkstone*, fetid calcareous spar. This would suggest by contrast a pleasant odour for the 'love-stone', but I have no stone for this latter, and moreover, the word *GUG-silim 'red of favour', leads us to think the connexion was due to the red colour. At the same time the stones must have had some outstanding qualities, be it colour or otherwise, to justify their names.

97 ^aRubuṣ-^{il}u^{al}pi, ^aŪ'. DINGIR.GUD, 'dung of the divine bull' (^{il}uGUD, the son of Shamash, KAVI. p. xiv).

In *MT.*: for *šunni e-* . . ., *KAR.* 213, iv, 1: when a man shivers in bed, *ib.* ii, 28: uncertain, *ib.* iii, 26: worn on neck, *AM.* 7, 1, 7: bind on temples, *AM.* 102, 34: bind on (*AS-su*) *Calendula, ^aŪ'. DINGIR.GUD, mustard, and hellebore, *KAR.* 205, 4 (cf. *AM.* 14, 3, 10). This last example, where the mineral is included with three plants (either hot or sneeze-provoking), and also as a remedy against shivering, suggests something like a rubefacient. Oil of amber, although a rubefacient, must, however, be regarded as impossible here. Cf. also *KAR.* 186, 41: r. 12 (against *AN.TA.ŠUB*).

98 ^aRubuṣ-^{il}uŠE.SAG, 'dung of ŠE.SAG'.

KAR. 185, iv, 18. ^{il}uŠE.SAG occurs in a list of 'ten gods in the temple of Adad', *KAVI.* 42, ii, 10.

99 ^aŠū,¹ ^aBALAG.GÁ, aban kašari, aban elligi, aban kanû, pumice-stone (the 'drum-stone', rubbing-stone, barber's stone, pen-stone), lava.

I have ventured to quote fully from my article in *Babyloniaca*, 1934, 57 ff., which M. Virolleaud was so good as to publish.

^aBALAG.GÁ = aban kašari = ^ašū ('H' 8). BALAG = 'drum' (*D.* 352, for literature), and hence ^aBALAG.GÁ = 'drum stone', a stone for kašari. Now the special part of a drum is its parchment, which is prepared essentially by being rubbed with pumice (see ^akakkus, No. 65). Pliny (*NH.* xxxvi, 42) describes pumice as used 'for imparting smoothness to the skin of females, and not females only, but men as well, and, as Catullus says, for polishing books. . . . Pumice is of a resolvent and desiccative nature; for which purpose it is submitted to calcination, no less than three times. . . . In a powdered state, pumice is used in ophthalmic preparations . . . as an ingredient in emollient poultices, being extremely useful for ulcerations on the head and generative organs'.

The description 'stone for kašari' should represent this action with pumice-stone, if the theory is correct: and in proof not only do we find *kuššarru* ('Pergamentschreiber', Schroeder, *ZA.* 1915-16, 91), but the Syriac *kīsrā*, *kīsrā* pumice, with the verb *k'sar* 'rub with pumice', and it is doubtless from this or the Assyrian that *κίονπος* the Gk. for 'pumice', comes.

In *MT.* it is pounded and used with others on a pledget to stay menses (cf. Pliny, above: *KAR.* 194, 1, 45). Less practically it is worn

¹ Once in error for ^aušū, No. 21 (g).

in amulets. The male and female are worn on a thread with others, on the pubes, by a woman with some menstruating trouble (*KAR.* 194, 4: cf. *ib.* 192, iv, 30): male and female are to be used with others when a man's eyes roll (*iššanundu*, see p. 168, *KAR.* 213, ii, 13, dup. *AM.* 46, 1, i, 26): both used against the *lamaštu*-witch (Thureau-Dangin, *RA.* 1921, 167), and they occur in a magical group, threaded (*K.* 4727): seven male *ašû*-stones are to be threaded and worn against *SA.GAL.LA* (swollen muscle) (*CT.* xxiii, 10, 23): again against the Hand of a Ghost (*AM.* 1, 4, 22+99, 2, rev.)¹: male *ašû*-stone with *aḫakkus*-stone, presumably for the muscle of the heel (*KAR.* 185, ii, 5: cf. *AM.* 70, 5, 5): *ašû*-stone with *aḫakkusa*[*ku*?]-stone,² for poison, *AM.* 91, 3, 8. It may well be that the smoothing power of the pumice has suggested it as an amulet for the skin, as well as its desiccating qualities in other cases.

ašû male and female makes seals (Thureau-Dangin, *RA.* 1921, 167, 2).

In v *R.* 65, b, 3 its polishing qualities are noted *kima šu-û ūmi unam-miršu* 'like pumice may the day brighten him', while it is possible that, owing to the similarity of the name of the *šû*-stone with the word *šû*, a flesh- or skin-disease, a punning reference may be seen in the use of the *šû*-stone (which smooths the skin) as an amulet against the *šû*-disease in the medical charm *KAR.* 192, iv, 10 ff., E., xiii, 133 ff. (which is followed by the prescription, quoted above, with male and female *šû*-stones heading the list of stones used) (10) [*šu-u šu*] *m-šu maš-ka-du ki-nu-us-su ul pa-ka-du* (11) *ki-nu-us-su šu-u šum-šu* (12) *ul-tu kakkab ša-ma-me ur-da* (13) *ur-dam-ma ul-tu kakkab ša-ma-mi* (14) *mi-šil im-ti ša šri il-ki mi-šil im-ti ša zuḫaḫipi il-ki* (15) *pi(?) -e la ŠA-in ŠA-in šin-ni šin-ni-šu ŠA-[in] ša-bit SA^{pl}* (16) *ubânât^{pl} su ŠA-in ša-bit kap-pal-* () *-ti* (17) *ki-ma šar-ti ḫa-līp la i-du ina šērēp^l*. 'Its name is [*šû*], the *maškadu*-sickness (rheumatism or similar) is its nature (?),³ its nature (?) is not *pakadu*: its name is *šû*; from a star of heaven it has come down, it has come down from a star of heaven: half the poison of the snake it has taken, half the poison of the scorpion it has taken. Mouth it has not, (but) it has a tooth; a tooth it has, it seizes on the muscles;

¹ I have re-examined *KAK* and can make nothing further or even certain about it.

² This must surely be read *kak-ku-sa* . . . , not *ni-ku-sa*

³ *Kimutu*, a rare word. In *PSBA.* 1908, 151 I suggested as its cognate the Syr. *kannē*, *kūnāyā* ('named', 'name'), but I think *k'yānā* ('nature') is also possible. E. also makes it 'Beiname (?)'. In *ul pakadu* Ebeling puts an exclamation-mark after *pa(!)* for the text of *KAR.* 192, but I suggest that *pakadu* may be the correct reading. If it be really *pakadu*, it would seem that we have a pun here on *maškadu* and *pakadu*, which suggests that the reading *maškadu* should be relinquished for *parkadu*: 'its nature (?) (name ?) is *parkadu*, its nature (?) (name ?) is not *pakadu*'. There is no word *pakadu*, and we must assume it to be for *parkadu* 'to care for'. At all events to say that its nature, or name, is and is not *maškadu* in the same breath is hardly sensible.

fingers it has not, (but) it seizes the *kappaltu* (of the leg); like hair it is peeled off,¹ not known (i.e. felt) on the flesh.' CT. xxiii, 11, 37 (PSBA. 1908, 151; cf. also E., *ib.*, and CT. xxiii, 4, 15) is parallel: (37) *Šiptu Šu-u šum-šû maš-ka-du [ki-nu]-us-su iš-tu kakkabāni^{pl} šā-ma-mi ur-da* (38) 'Charm. Šû is its name, the *maškadu*-sickness is its nature (?): from the stars of heaven it has come down', and then the text goes on to enumerate the parts of the body it (the disease) has 'seized'. There are instructions several lines before (CT. xxiii, 10, 23), for the male *šû*-stone to be threaded and worn.

This brings us to *aban elligi*.

The value *²šû* for *aban elligi* is clear from 'J' 57 (cf. 'H' 9, note), *aban e(i)lligi(u)* being equated with *aban ḫanû*, and *aban ḫanû* with *²šû*, following close on the *²šû* group.

The meaning 'pumice' for *aban elligi* (note that the genitive occurs) suggests the Arab. *ḫalaḫa* 'shave', the Arabic *ḫ* constantly giving *e* in Assyrian (*emetu*, *immu*, *ensu*), and Pliny's description of pumice for smoothing the skin of men bears this out.² *Elligi* will then be the Assyrian for the Arab. *ḫallāḫ* 'barber'.

Aban ḫanû (or *²ḫanû*) 'the stone of the reed-(pen)' again indicates that the reed-pens were kept pointed by pumice stone (similar to our old word 'pen-knife'). A value *²ZID.IM* and *²AŠ.MUR* 'powder of clay' and the equivalent for emery and antimony (powder) for *²BALAG.GĀ* is given on 'J' 48, 49. The Semitic cognates for *²šû* will be found under *²šû*, No. 83, since it is difficult to distinguish the *s* and *š*.

Lava is found on the Karaja Dagħ (W. W. Smyth, *A Year with the Turks*, 74) and at Bitlis (*Tr.* ii, 369). The *šadi^u Kašīari*, a point which I have for some time held, must represent the modern corrupt name Karaja Dagħ (coinciding well with the accepted position), just as the Maklūb Hills, E. of Mosul, represent Sargon's Magganubba, and the association of lava on the Karaja Dagħ, with its old name Kashīari so akin to *aban kašari* 'pumice', seems definite. The inserted *i* in *Kashīari* appears in numerous place- and personal-names in countries N. and NW. of Assyria (Aiusiaš, Arsiyaniš, Andiabi, Matiat, &c.). (For a description of the Karaja Dagħ, see *Tr.* ii, 110.) Pumice is plentiful in the volcanic district N. of Assyria (Loftus, *Quart. Journ. Geol. Soc.*, 1855, 314, &c.).

To sum up: *²šû* is pumice stone (lava), used specially for preparing the vellum of drums (*²BALAG.GĀ*), for *kašari* (rubbing), and as the

¹ Here the reference is to the depilation by pumice (preferably to Ebeling's reading *hima širti ḫarib* 'wie der Morgen naht er').

² Rather than the Heb. *ḫālāḫ* 'smooth', Arab. *ḫalaḫa*, which will not give a good Assyrian equivalent. Perhaps I might add here that I heard a barber's whetstone called *beleg* in Basrah, but there is no reason to suppose it had any connexion with *²BALAG.GĀ*. Is it too fanciful to see the origin of *pergamentum* 'parchment' in *balaggu(m)*?

the barber' (*aban elligi*), indicating the way in which hair was
and it was used for sharpening reed-pens (*aban kanû*). It
ly was supposed to be able by its sympathetic magic as a
g stone to smooth away skin- or flesh-troubles. It either took
from, or gave its name to, the Kashiari mountain, the modern
agh, and it is the origin of the Greek *κίονης*. It is possibly,
ter form, a doublet of **KA.ŠUR.RA*.

gugarum (or **ēni-gugari*), **maḥritu*.

: 'J' 62. Unknown.

.GA.RA, unknown.

eller, *AOTU*. i, 4, 311, 16, 18.

mmu, **ŠAM*, hard red sandstone (?).

it by Anp. from Hindana in the Middle Euphrates (*AKA*. 287,
er, gold, tin (*AN.NAP*), copper (*ZABAR*), **šammu*, **GIŠ*.
'L, &c.'). In Geller, *AOTU*. i, 4, 294, 1, *ḫarradu ana šammi*
izziz-ma 'the hero stood on the *Šammu*-stone', and *ib*. 296, 29,
ŠAM) *ina taḫazi kima kalbe ša kapparri 'kakku ukaššidšu* 'O
tone, like a shepherd's dog they shall make him take it as a
perhaps meaning, as a weapon against a shepherd's dog (every
knows what pests these are in Mesopotamia, and how a stone
generally drives them away, except in Anatolia), that is, its
vious from Anp.) shall be reduced to that of a pebble (?).
here is one of the poor Assyrian puns on this name *šammu* in
lines (31 ff.) *bēliku sānta (*GUG) ina palaši šuma šuātu lū*
am lord. Be this name called *sāntu* (red stone) in the boring'.
nu is a red stone from Hindana, it may well be that it is the
of the stela of hard red sandstone which we found at Nineveh
x, 1934, 113) which commemorates the gift of the province
na to Nergaleresh by Adad-nirari III.

numa, unknown.

it by Anp. from Carchemish (*AKA*. 367, 68).

šamê, unknown.

n *MT*. in the case of a woman whose uterus is flooded with
parently, for rubbing her downwards, mixed with various
būru-oil (*KAR*. 196, iii, 7). The phrase *kima tiḫ samê la*
occurs *NK*. 60, ii, 8 (Nabopolassar), 'like the unmeasured
'heaven'. There must be some similarity between the 'drug'
he woman with flooded uterus, and the 'streaming' of heaven,
ifficult to see what connexion a 'stone' will have, unless we are
the determinative and translate boldly 'rain' in *MT*.

105 (a) ^aTUR.MI.NA, coloured marble (?), or some calcareous stone (?).

105 (b) ^aTUR.MI.NA.BANDA ('small TUR.MI.NA'), breccia.

The meaning of (b) was settled by Koldewey's discoveries at Babylon ('rotweis (*sic*) glasierte, vulkanische Breccia', *Aiburschabu*, 6: Ebeling-Meissner, *Realex.*, i, 437). It was brought by Senn. from Kapridargila¹ (King, *CT.* xxvi, vi, 59) on the borders of Til-Barsip (Tell Ahmar, 14 miles below Carchemish), breccia being found at Birejik, some few miles N. of Carchemish, *A.* 94. It is worn against *AN.TA.ŠUB* (stroke of some kind), *KAR.* 213, ii, 7. (Breccia of blue limestone comes from the Jellu Mountains, not far from Julamerk, *Tr.* ii, 291.)

^aTUR.MI.NA was found at Uizuku, the mountains of the *burašu*-pine, by Sargon (not far from Lake Van, *HC.* 280, n. 2). Meissner makes it marble (*BA.* iii, 212); Thureau-Dangin, a coloured marble (*HC. ib.*). There is a quarry of calcareous stone near Akantz, on the NE. edge of Lake Van, near the ruins of Arjish (which I suggest might be the Arzugu of *HC.* 282) (H. F. B. Lynch, *Armenia*, ii, 25, quoting *La Turquie d'Asie*, ii, 210 (Vital Cuinet)). Esarh. received both (*PE.* 26, 79), and both (a) and (b) occur *CT.* xiv, 16, 93084, r. 1, 2: *AM.* 29, 2, 8-9: *AM.* 102, 31 (to bind on temples). The former (a) only, *AM.* 7, 1, r. 6 (for favour of a ruler?). Is ^aKU.MI, *KAR.* 213, ii, 23, a mistake?

¹ Can this be an Assyrianized form of a Syr. *kaṣrâ d'arg'lâ* 'village of yellow earth'? *Arg'lâ*, however, may be the Greek ἄργιλος, which would make it unlikely, at all events so far as the Greek word affects it.

APPENDIX I

THE GLASS RECEIPTS

THESE are the actual components in the receipts for making glass from tablets of the seventh century B.C. from Kouyunjik now in the British Museum. From one colophon certainly some of these tablets had been deposited in the Library of the Temple of Nabû. Since the two previous publications of them (Zimmern, *ZA.* xxxvi and mine in *OTC.*) I have been over them again, and have added some new fragments, and I propose to re-edit them in full.

A. (*To make the furnace.*)

B. *To make* ^a*zaginduru* (*simple glaze*).

10 mana sand, 15 mana alkali ash, 1 $\frac{2}{3}$ mana *šarbatu* (styrax).

C. *To make tersitu* (blue copper frit).

10 mana of copper (*er^zum*), 10 mana of *zuku^u*-glass.

D. *To make zuku^u* (some simple glass or glaze).

. . . sand, 12 mana *aḥussu*-glaze, . . .

E. (*Omit, as this is now included in C.*)

F. *To make* ^a*uknū* (*blue glass or glaze*).

10 mana of *tersitu*, 10 mana of *siṣu* (see CC), . . . of alkali (*ḥarṣu la taiaru*, sharp, not round), $\frac{2}{3}$ mana of lime of the sea, (some) *sāndi kalitu* (one text adds 1 shekel washed saltpetre).

G. *To make* ^a*uknū merku* (moulded blue glass).

1 mana of *tersitu damḳu* (sic) (fine blue copper frit), $\frac{1}{3}$ mana of crushed *siṣa* (see CC), $\frac{1}{3}$ mana of sand, 5 *kisal* of lime.

H. *To make* ^a*uknū me[rku]* (moulded blue glass).

1 mana of *tersitu* (blue copper frit), 3 mana of *tarabanu šadda* (scraped carbonate of soda (?)), 10 *kisal* of *siṣu* . . . (), 5 *kisal* of lime of the sea . . . , . . . of *sāndi* (litharge), 2 *kisal* of saltpetre, 3 shekels of *šipū*-arsenic, 5 *kisal* of male red alum, 6 *kisal* of *lêru*-arsenic, 6 shekels of styrax.

I. (*Note about the furnace.*)

J. *To make* ^a*uknū [merku] (?)* (moulded blue glass?).

3 mana of *tersitu* (blue copper frit), 8 mana of *zuku^u*-glass, 1 $\frac{1}{2}$ mana of ^a*[ša-da]-a* (quartz?), 12 *kisal* of saltpetre.

K. *To make* ^a*uknū merku* . . . (moulded blue glass).

1 mana of *tersitu* (blue copper frit), 2 mana of *šadā* (quartz (?)).

L. *To make* ^a*uknū [merku] (?)* (moulded blue glass?).

1 mana of *tersitu* (blue copper frit), 1 $\frac{1}{2}$ mana of *šadā* (quartz (?)).

M. *To make* ^a*uknū sâ[mu]* (red or red-purple glass).

1 mana of *tersitu* (here red copper frit),¹ 1 $\frac{1}{2}$ mana of *siṣu*-glass, $\frac{1}{2}$ mana of sand.

¹ This must here be made from red copper oxide, and not, as in the previous case, from the black copper oxide, since the method for making this form of

N.+O. *To make the tersitu (red copper frit) for the above (with siparru arḫu 'scaled copper').*

10 mana of aḫusu-glaze, 10 mana of ^a[sand?], adding 3 mana of erū arḫu 'scaled copper'.¹

P. *To make sirṣu natku (smelting (?) glass).*

5 mana of salicornia-alkali ash, 4 mana of sand, (some) male saltpetre, 5 shekels of lime.

Q. *To make sipru (sapphire).*

1 mana of tersitu of ^auknū (blue copper frit), 1 mana of sirṣu glass.²
(R. is mutilated.)

S. *To make green crystal.*

(Thou shalt melt the same as the preceding?) with ^aĀŠ. GE₄. GE₄-arsenic, followed by 1 mana of ^aba-aš(?) . . . , 1 kisal of washed saltpetre, washings of tuskū (spodos), 1 kisal of lime, 1 kisal of alkali.

T. *To make dušū (crystal).*

20 mana of sand, 1 talent (60 mana) of salicornia-alkali, 2 mana of saltpetre, 10 shekels of lime, 1 mana of tuskū (spodos), 6 shekels of lulū (pompolyx).

U. *To make [yellow (?) glass].*

1 mana of zukū-glass, 15 kisal of [alkali (?)], 10 kisal of antimony (?).

V. *To make opaque (?) red(-glass).*

1 mana of clear dušū-glass, 15 kisal of tuskū (spodos).

W. *To make opaque (?) marble (alabaster).*

1 mana of clear dušū-glass, 10 kisal of tuskū (spodos).

X and Y. (Uncertain purpose).

Z. (Lost).

AA. *To make ^asāndu marḥašitu (sandaresos, aventurine).*

. . . mana of . . . šaddā (?), 10 mana of aḫussa-frit, . . . mana of unwashed saltpetre, $\frac{1}{2}$ mana of damatu-arsenic.

BB. (A repetition of T.)

CC. *To make sirṣu-glass.*

20 mana of sand, 1 talent (60 mana) of salicornia-alkali, $1\frac{2}{3}$ mana of saltpetre, $\frac{2}{3}$ mana of lime.

DD. *To make [ba]hré (?) (red coral, i.e. the Purple of Cassius).*

1 mana of zukū-glass, 16 kisal of [tus]kū (spodos), 10 kisal of aba . . (antimony(?)), . . . of saltpetre, $\frac{1}{2}$ kisal of go[ld]. . .

EE.-II. (Mutilated or uncertain.)

KK. Uncertain.

tersitu follows in Sect N., and, as Mr. Searle was so good as to write and point out to me, there is otherwise no red colouring agent unless 'a special sand were used, or unless the sirṣu glass were coloured'.

¹ Note the difference in the two parts of this text, siparru arḫu and erū arḫu, for no apparent reason. This and other details suggest a composite text.

² There is, however, a curious reference to ^ašipru ša siparri arḫi ša dulli in the last line of the receipt.

2 mana of *mekku*-mineral¹ . . . (?), $\frac{5}{8}$ mana of sand, $\frac{2}{3}$ mana of . . . ,
 1 *kisal*, 22 $\frac{1}{2}$ grains of . . . , 1 *kisal*, 22 $\frac{1}{2}$ grains of *ka*-[*al-gu-ga*] (*rubrica*, red
 ochre). LL. To make rouge (?).

. . . of [*k*]*alguga* (*rubrica*), 1 shekel of *tra*[*gacanth*].

MM. To make *širdû* (?) (*sard* (?)).

. . . *šaršera* (red substance). . . .

A note on *Ešmarû* 'enamel', glaze.

The word comes into Assyria in the third quarter of the seventh century, when Ashurbanipal refers to it as *ešmarû ibbu*, 'bright *ešmarû*', from former kings of Elam. In Persian times its Elamitic (Susian) form is *ismalu*, it being made during Darius' period by Sardians and Egyptians (Scheil, *MMAP*. xxi, 1929, 33). The proof of its meaning lies in Nebuchadnezzar's description of *agur ešmarê* (i R. 54, iii, 56) 'burnt bricks of *ešmarê*' with which he adorned the Temple-way in Borsippa, as contrasted with his *agurri auknû ellitim* 'burnt brick of shining glaze' (*ib*. vi, 4; cf. i. R. 51, i, 25) for Babylon. Pinches was right in comparing 'enamel', *émail*, (S. A. Smith, *Asurb.* ii, 70-1). Skeat (*Etym. Dict.*, 566), defines 'enamel' as a doublet of 'smelt', with a base 'smalt', to become oily, for SMART (Aryan SMARD) 'formed as an extension from *smar*, grease', with which *μέλδομαι*, to become liquid, is comparable. The Assyrian word thus comes very close to the Aryan form. It has nothing to do with the Heb. *ḥašmal*, which is *elmešu*. Smalt, properly, is 'an artificial preparation of the nature of glass coloured by a cobalt compound' (*AEMI*. 218).

Nabonidus made two *lahmu*-monsters of *ešmarû* (v R. 64, ii, 16), and a contract during his reign (*Nbn.* 241) begins (1) *siparru mušahḫinu* (2) *ašmarû ša ina pân^{ilu} Nabû-aḫē^{pl} -ukin apil-šu ša^m Aplā u^{m ilu} Nabû-aḫē^{pl} -ukin ana Bît-Zupuhrê (?)^{pl} iddinu* (a copper cauldron enamelled dedicated to the 'House of Zupuhrê (?) -cedars'). What this enamelled cauldron actually is is, of course, uncertain.

¹ *me*- . . . , restored from an additional fragment of another section, giving *me-ik-ku*.

APPENDIX II

The Babylonian Glass-text¹ published by Mr. C. J. Gadd and myself in *Iraq*, 1936, iii, 87, contains the following:

(a) A glaze called *Erû abari*, 'lead copper':

- 1 mana *zuku*-glass (*a₇-ba₇-an zu-ka(k)-i*)
- 10 shekels lead (*a₇-ba₇-ram*)
- 15 shekels copper (*URUDU*)
- $\frac{1}{2}$ (shekel) saltpetre (*AN.NE*)
- $\frac{1}{2}$ (shekel) lime (*ZALAG-ram*)

(b) A glaze called *Erû Aggaditu* 'Akkadian copper':

- 1 mana *zuku*-glass (*a₇-ba₇-an zu-ka(k)-i*)
- $\frac{1}{6}$ (mana) (= 10 shekels) lead (*a-bà -ra*)
- 14 (shekels) copper (*URUDU*)
- 2 shekels lime (*ZALAG-ram*)
- 1 shekel saltpetre (*AN.NE*)

(c) The formation of a green clay 'body' for a pot, by steeping the clay in copper and vinegar for three days.

(d) The triturating and melting together of equal parts of glazes (a) and (b), and adding to 1 mana of this melt these additional substances:

- 1 $\frac{1}{2}$ shekels *zuku*-glass (*aban zu-ka(k)-i*)
- 7 $\frac{1}{2}$ grains (*ŠE*) saltpetre (*AN.NE*)
- 7 $\frac{1}{2}$ grains (*ŠE*) copper (*URUDU*)
- 7 $\frac{1}{2}$ grains (*ŠE*) lead (*A.BÁR*)

which is all to be triturated, melted, and cooled.

(e) The placation of the spirit of a 'dead man'.

(f) The dipping of the pot in the glaze, followed by the firing.

(g) A repetition of the firing.

(h) A fresh 'melt' (either after the glaze has turned from 'copper clay' (*IM.URUDU*) to 'copper gum' (*Á-DAN ša₁₀ URUDU*), or, in order to make it so), added to (?) the glaze (on the pot?):

- 1 mana 2 shekels *zuku*-glass (*a₇-ba₇-an zu-ka(k)-i*)
- 15 grains (*ŠE*) copper (*URUDU*)
- 15 grains (*ŠE*) lead (*A.BÁR (GÚG)*)
- 15 grains (*ŠE*) saltpetre (*AN.NE*)
- No lime (*ZALAG-ram*)

(i) In order to preserve the glaze for future use, store it in an old wineskin.

¹ Dated in the reign of Gulkishar (seventeenth century B.C.)

CUNEIFORM SYLLABARIES
OF
MINERALS

'A'. K. 4325 + 13692 + Rm. 474, Cols. IV-VI (CT. xiv, 3); K. 4368, Cols. IV-VI (*ib.* 5); 81-7-27, 147 (Meissner, *Suppt.*, pl. 27).¹

Page	IV	V	VI	
2	..... a(?) . RA	..... a-ban [mar-ti]	.....
183	aSIL	" i-[ša-ti]		'bitter' stone
88	aDINGIR.BABBAR	" Ša-[am-šī]		'fire-stone', iron pyrites
88	aGAR.GI.NA	" kit-[ti]		'sun-stone', similar
5	aSU.GAR.TAK ³	" ki-i-s[ī]		'stone of truth'
	aGAR.DU ₁₃ .DU ₁₃	" šī-ib-ir-ti		'small' stone
	aŠUSSAN.A.ṬU	" šī-ib-ri-[ti]		'small' stone, $\frac{1}{3}$ shekel
10	aIGI.3.GÁL.LA	" $\frac{1}{2}$ ma-na	(see 'D' 17)	$\frac{1}{2}$ mana
	aMUL.UG	il-lu-ku		
	aSUH.SAR	ti-ik-mu		
	aGAR.TAG.GA	su-du-ru		egg-shaped bead
107,	aNUNUZ	e-rim-ma-tu		
Int. § 13				
	aNUNUZ. GÜ	---5		
Int. § 13	aNUNUZ.DU ₁₃ .DU ₁₃	ni-t-[ru]		necklace of egg-shaped beads (?)
Int. § 13	a _e -rib(?) .di-e ⁵ -tu ⁶	šip-ri-e-[tu]		small egg-shaped beads
15	aPES ₄ .ANŠU	" ...		?
109		bi-iš-šur a-t[a-mi]		'sexual part of a she-ass', belemnite (?)

¹ This fragment does not join either of the preceding tablets, but it has every appearance of having formed the right-hand column, probably of K. 4368: Cols. I-III of K. 4368 are certainly broader than Col. V, and so the narrowness of the column on 81-7-27, 147 would thus agree. There is little distinctive in the cuneiform characters of the two texts to point to a definite similarity between the two, but at the same time they show nothing which prevents the two from belonging to the same tablet. ² This column refers to pages herein. ³ = *k[i-i-su]*?, Thureau-Dangin, *RA*. 1919, 171 (AO. 2163 B); *MAA*. 412 (Heb. *ebhen kfs*). ⁴ Here K. 4368.

⁵ K. 4368 omits. ⁶ K. 4368 *tum*.

104	^a PEŠ ₄	¹ is-sil-lat; is-kil-lat	---		'pregnant stone', <i>aetites</i>
104	^a PEŠ ₄ . PEŠ ₄	ši-kin-[nu] . ²	---	³ iš-ku-il-la-tum	botryoidal haematite
104	^a PEŠ ₄ . PEŠ ₄	ha-an-da-pil-[lum] [.] ⁴	---	³ "	"
98	^a ša-ma-a-a-tum	ŠU-u (= ZUR šargubbi)	---	⁵ nu-ši-il-tum	'heavenly (blue)', blue vitriol
89	^a ZUR. ŠAR. GUB. BA	ŠU-u (= marbušū)	---	⁵ ia ₄ -ni-bu	'decomposition of pyrites', green vitriol
101	^a mar-lu-šum	tar-ma-nu ⁷	---	⁵ ha-an-na-bab-ru	iron pyrites: 'fuming fetidity' (oil of vitriol)
111	^a sag-gil-mut	i-mi-ib ka-ra-ši	---	⁵ [sa]g-gil-li-mut	nodule of iron sulphide, 'thunder-bolt'.
54	^a GURUN. GA. RAŠ ŠAR	pu-u[š(?)]- pu-[uš(?)]-	---	⁵ [aš]-ki-ku-ú	native arsenic
172	^a ĪAR. ĪUM. BA. ŠIR	ba-a[š]-ri-e	---	⁵ [bab]-ri-e	(red) coral
167	^a KU BAL. E	?	---	⁵ [aUD + ŠAL] + KAB(?)	amethyst, corundum
184	^a KALAG. GA		---	⁵ [u-u] ¹⁰	whetstone

¹ From 'D', CT. xviii, 26, Rm. 339, 4. ² 81-7-27, 147 uncertain.

blank on K. 4368, IV-V, that Col. VI contained an additional word.

⁶ K. 4368 *GI.LI.MUT* (so read with Meissner, text re-exd.).

⁸ From 'D', CT. xviii, 26, Rm. 339, 16 (= *aš-gi-ku-ú*): K. 4368 *i-mi-ib ka...*

words. (L. 1 of K. 4232 is found as a catch-line on K. 2020, CT. xviii, 31.)

³ From 81-7-27, 147. In l. 19 it would appear from the Cf. 'C' 14, *mu(?)-ši-il*: (= *tu*). ⁵ From 81-7-27, 147.

⁷ 'D', CT. xviii, 26, Rm. 339, 15 (= *AN. AN. gi-bl-mut*).

⁹ Here K. 4232 (CT. xiv, pl. 17) begins with these two

¹⁰ From 'H' 1, 2.

'A' (cont.)

Page	IV	V	VI	
184	¹ KA.ŠAL.LA	[su-u] ²	.....	whetstone
185	^a SAG.KAL	.....	.....	diorite, dolerite
163	^a e-si ³ KAL	[u-šu-u] ⁴	.....
		⁵ -----	⁵ -----	
160	^a AD.BAR	[ŠU-rum (= adbarum)]	[[š]a-lam-tu]	basalt, lava, pumice
160	^a ĦAR.AD.BAR	[e-[ru]-u ad-ba-ri] ⁵	.....	mill of lava or basalt
Int. § 15	^a ĦAR.DUK.KA.BUR	[„ pa-ĥa-ri] ⁵	.....	potter's wheel

Int. § 15	^a ĦAR si-bu-um	[e-ru-u si-i-bi]	[e-ru-u ĦA.ŠI.ĦAR]	
	^a ĦAR..... ⁷	.....	.....
	^a ĦAR..... ⁷	.....	.....
	
40				

¹ Here K. 4232 (CT. xiv, p. 17) begins with these two words. (L. 1 of K. 4232 is found as a catch-line on K. 2020, CT. xviii, 31).² From 'H' 1, 2. ³ Probably the correct reading. ⁴ D. 322, 37. ⁵ From 'C' 18, 19, 20, 17. ⁶ 'C' 17, ^aĦAR si-e-bi.⁷ See 'C' and 'F', and SLT. 179, iii, 17 ff.

'B'. K. 4396 (*CT.* xiv, 14), 7 ff.; S. 995 + Rm. ii, 339 r. (*ib.*, and *CT.* xix, 8); *Mat.* 86, Cols. 4-6, 1-6 (note 'C'; taken from l. 7, *ib.*, which thus continues 'B').

	Page	I	II	III	
	113 114	^a <i>mu-su</i> ^a <i>ĤAR.ZABAR.NAM.MULU.GIŠGAL.LU</i>	<i>šd līb ú-ru-la-ti-šú</i> <i>abam³ e-ri-e</i> <i>abam⁵ la „</i>	<i>pap-pal-tu šd bir-ki ameli</i> <i>abam bir-ki ameli</i>	misy, ¹ sulphate of copper or (and) iron ('pollution of the penis of a man')
10	104 108	<i>a</i> <i>PEŠ₄</i> ² <i>a</i> <i>NU.PEŠ₄</i> ⁴	<i>abam³ e-ri-e</i> <i>abam⁵ la „</i>	<i>INIM.INIM.MA.BI</i>	'pregnant stone', <i>aetites</i> 'stone of not conceiving'
	108	<i>a</i> <i>Ū.TU</i>	<i>abam⁵ a-la-di</i>	<i>a</i> <i>il-la-mir</i>	'birth stone', the small stone in the geodes
	109	<i>a</i> <i>NU.Ū.TU</i> ⁴	<i>abam⁵ la „</i>	<i>a</i> <i>la-a-a-i-ku</i>	'the killer', an abortifacient
	188	<i>a</i> <i>KI.ĀG.GĀ</i>	<i>abam⁴ ra-a-me⁶</i>	<i>a</i> <i>GUG.si-lim</i>	'love stone'
	188	<i>a</i> <i>NU.KI.ĀG.GĀ</i> ⁴	<i>abam la „</i>	<i>a</i> <i>ĤUL.GIG</i>	'hate stone'
15	169 ⁷ 157 183	<i>a</i> <i>IGI.ĤU⁸.NA</i> <i>a</i> <i>ĤU⁸</i> <i>a</i> <i>ĤA</i>	<i>a</i> <i>i-ni iš-su-ri</i> <i>a</i> <i>iš-su-ri</i> <i>abam nu-ū-ni</i>	<i>a</i> <i>kī-il-la</i> <i>a</i> <i>ZA.TU.PA.ĤU⁸.NA</i> <i>a</i> <i>IGI.LAG.GĀ</i>	'bird's eye stone' 'birdstone' (<i>Smaragdus Medicus?</i>) 'fish-stone'

¹ I see that Taylor, 'Survey of Greek Alchemy', *Journ. Heli. Studies*, 1930, 124, considers it basic iron sulphate. ² The *a* added in S. 995 indicates the very small *a* in the middle of the *PEŠ₄* sign, lest through some scribal error or flaw in the clay it should be uncertain. ³ S. 995, *a-ban*. ⁴ *Mat.* „. ⁵ S. 995 and *Mat.* „. ⁶ *Mat.* 86, *mu*. ⁷ See 'C', i.e. *Mat.* 86, 4-6, 7 from here onwards. ⁸ Or read *MUŠEN*.

	Page	4	5	6	7
10	176	<i>aDÜ.ŠUB.BA</i>	[šik]¹-ka-ti	<i>hal-tum</i>	alum-stone, alunite (probably)
	183	<i>aĦA</i>	[aban] nu-u-ni	<i>aIGI.LAG.GA</i>	'fish-stone'
	157	<i>aĦ[U]²</i>	[iṣ]-ṣu-ri	<i>aZA.TU.PA.ĦU².NA</i>	'birdstone'
	169	<i>aIGI.ĦU².NA</i>	i-ni iṣ-ṣur	<i>aḳi-il-lū</i>	'bird's eye stone'
	1	<i>aMUN</i>	.. (?) ta-ab-ti	<i>aMUD</i>	salt, 'stone of blood'
15	178	<i>aSILA.ŠAR</i>	[,]³ ka-ṣi-e	<i>aGUG.SILA.ŠAR</i>	'rose-red stone (lepidolite, probably)
	160	<i>aELTEG</i>	[,]⁵ i-lu-lū	<i>ad-ba-rum</i>	pumice (like burnt alkali)
	98	<i>ašá-ma-a-a-tú</i>	mu(?)⁶-ṣi-il;	<i>mu-ṣi-il-tú</i>	sulphate of copper, blue vitriol
	Int. § 15	<i>aĦAR.ŠU</i>	e-ru-u ka-ti	<i>e-ru-u . . . -du-ri</i>	'handmill'
	Int. § 15	<i>aĦAR.ŠU</i>	erā(ĦAR) ba(?) -ba-su (ṣi(?))	"	'baker's mill'
20	Int. § 15	<i>aĦAR ṣi-e-bi</i>	e-ru-u ṣi-i-bi	" <i>ĦA.ŠI.ĦAR²</i>	basalt, lava, pumice
	160	<i>aAD.BAR</i>	ŠU-rum (= adbarum)	[š]⁸-lam-tú	mill of lava or basalt
	160	<i>aĦAR.AD.BAR</i>	e-[ru]-u ad-ba-ri	[,]	potter's wheel
	Int. § 15	<i>aĦAR.DUK.ĶA.BUR</i>	" pa-ḥa-ri	... ṣi(?) ...	stone of the <i>addu</i>
	Int. § 15	<i>aḳak(?)⁹-ka-ru-u</i>	e-rim-ma-tu	<i>abnu šd amādūpi</i>	'pregnant stone', <i>aetites</i> ('case-tablet')
25	104	<i>aPEŠ₄</i>		<i>la-ḫ(-)iāk(ia₄)-na-te</i>	'sexual part of the she-ass' (belemnite?)
	110	<i>aPEŠ₄.ANŠU</i>	[bi-iṣ-ṣur a]-ta-a-ni	<i>pu-ra-d(i)a-a-ti</i>	botryoidal haematite
	104	<i>aPEŠ₄.PEŠ₄</i>	š[i-ki]n-nu	<i>iṣ-ki-il-la-tú</i>	"
	104	<i>[aP]EŠ₄.PEŠ₄</i>	ḫa-[an-da-p]il-lu	"	"

¹ From 'E', CT. xiv, 16, K. 6003, 8, [*aDÜ.ŠUB*]. BA = ", (= *aban*) *ta-ab-ti šik-k[ā-ti]*.
 ² Or read *MUŠEN*.
 ³ *Ib.*, 1, *aban*.
 ⁴ Restored from a stone of this name, see p. 178.
 ⁵ 'E', CT. xiv, 16, K. 6003, 2, ".
 ⁶ It must be thus from 'H' 15.
 ⁷ See 'A' 37. *Introd.* § 15.
 ⁸ Or [*ṣal*].
 ⁹ Or ... -pa-ka-ru-u.
 ¹⁰ From here onwards cf. 'E'.

Int. § 15	¹ NA	na-[du]-u	abnu šd amaškapi	currier's mallet
Int. § 15	^a NA.RÚ.A	na-[du]-u	na ² -a-du šd tiiti	to 'throw' clay
Int. § 15	^a NA.RÚ.A	na-[ru]-u	a-su-mit-tu	stone memorial
Int. § 15	^a NA.PUR	pi-[i-lu]	abnu pi-šu-u	white limestone
Int. § 15	^a NA.GÚ.BI.NA	ŠU-[ku]	[duš]-tu	
Int. § 15	^a NA.ZA.GIN.NA	ŠU-[ku]	[„] ²	
Int. § 15	^a NA.ZAG.HI.LI	ur-[šu]	[ma-s]ak-tu	mortar
Int. § 15	^a NA.ŠU „	[e-lit „]	[„]	pestle
30	.....	.....	.....

¹ Cf. 'E' 5 ff.: 'H', r. 47 ff.

² Cf. 'D' 10.

'E'. K. 6003 (CT. xiv, 16): cf. 'F'.

	Page	I	II	III
5	178	[^a SILA ŠA]R	^a ka-si-[e]	'rose-red stone' (lepidolite, probably) pumice (like burnt alkali) 'stone against the lamaštu-demon' (see 'G' 19) alum-stone, alunite
	160	[^a] ELTEG	„ ú-ḫu-[i]	
		[^a R]AB.KAM.ME	„ la-maš-ti	
		[^a]LA.RA.AḤ	„ šup-šuk-ti	
		[^a Z]IK.BAR	„ im-ši	
10		[^a]MULU DU ₁₄	„ šal-ti	
		[^a KA.ŠIR].NI.KÚ.E	„ šup-šuk-ti	
	176	² [^a DÜ.ŠUB].BA	„ ta-ab-ti šik-k[<i>a-ti</i>]	
		[^a].....NE	„ te-.....	
		.....	ŠU-u.....
		a-ban(?).....	

¹ Cf. SAI. 468.

² Cf. 'C' 7.

'G' Ritual text: Langdon, *UMBS*. xii, i, vii (cf. iv. R. 25 and *TL*. 121).

(After the physician has drawn near the sick man and entered the house) Rev. 11-15: 'the little stones shall be crushed (*IM.ZI.IR.ZI.IR.E.NE*), the great stones like water shall be dissolved (*MU.UN.ZAL.ZAL.E.NE*),¹ the fire burns,² the body shivers,³

16	(See	<i>aNUNUZ e-rin-ma-tum</i> ^a <i>ZALAG (ZÁ.LAH) nam-rum</i>
17	Int. § 13)	<i>aNUNUZ.GU ni-i-rum: aŠI</i> ^a <i>mar-tum</i>
18		<i>aNUNUZ.TAB.BA</i> „ : <i>aBIL</i> „ <i>i-šd-tum</i>
19		<i>aNUNUZ.III.TAB.BA</i> <i>šip-ri-e-ti</i> ^{a?} <i>MULU.DU</i> ₁₄ „ <i>ša-al-tum</i>
20		<i>aNUNUZ.DU</i> ₁₃ . <i>DU</i> ₁₃ . . . ^a <i>ARRUŠ</i> ⁴ „ <i>ri-e-mi?</i>

(The difficulty is to decide on the method of translating these stones; are they for magical use for a patient suffering from stone in the kidney? 'The stone-bead-enclosed-in-another (is) lime; the *niru*-necklace stone (is) "bitter"-stone (gall-stone?); the *tabba*-necklace stone (is) pyrites; the 3-*tabba*-necklace stones (are) "hate"-stones; the "small"-necklace-stones (are) "love"-stones'? For the *NUNUZ*-stones see Int. § 13.)

¹ *Unarrabu*.

² *Iarranu*.

³ *Unarraṭu*.

⁴ *D. 271, 5.*

'H'. K. 4232 (CT. xiv, 17, cols. I-II): K. 240 (*ib.* 15).

	I	II	
5	1 ^a KALAG.GA	^a su- ^u 4	whetstone
	^a KA.ŠAL.LA	^a su- ^u 4	"
	^a GAR.ŠAG.GA	^a lamassu	agalmatolite
	^a KI.NAM.AN.NA	^a SAK.KI	'stone of the temples'
	^a MAH	^a KI.ĀG.GĀ	'love-stone'
10	^a ba-aḫ-ri-e	^a ḪAR.ḪUM.BA.ŠIR: ^a mu-sal-tú ²	red coral
	^a KÛ.BAL.E	^a UD+ŠAL+KAB: ^a ĀŠ.MUR ²	amethyst, corundum, emery
	^a BALAG.GĀ	-----	'drum-stone', rubbing stone, pumice
	^a ban el-li-gu ³	^a ban ka-ša-ri: ^a ṣu-u	'barber's stone', 'pen-stone', pumice
	5 -----	^a ban ka-nu- ^u 4	'pen-stone', pumice
15	^a ...-u	-----	green vitriol
	^a ZA.SUH.UNU.KI	^a ban ka-nu-u	"
	^a ZA.SUH.UNU.KI.GAL	^a id'-ni-bu	'green vitriol two coloured (?)'
	^a q-ri-a-bu	^a ZA.SUH.SIG ⁷	(vitriol of) cobalt
	^a ša-ma-a-a-tum	^a bur-ru-mu(?) ⁸	colcothar, red vitriol
15	^a a-lal-lum	^a ZA.SUH.ki-bal]-ti	sulphate of copper, blue vitriol
	^a BUR.ŠU.ŠAL.LA	^a ZA.SUH.DIR ¹⁰	probably a yellowish limestone
		^a mu-[si] ¹¹ -tum	
		^a a-[la-lum] ¹²	
		^a bur-šid-ši-[lu] ¹³	

¹ See CT. xviii, 31, r. 30, for catchline.
² Not on K. 4232.
³ K. 240, gi.
⁴ K. 240, u.
⁵ This line not on K. 4232.
⁶ For the following cf. Langdon, RA. 1916, 187: (1) ^aZA.SUH(ŠUBA) = šu-bu-u (2) ^aZA.SUH.UNU.KI = ^aa-ni-bu (3) ^aZA.SUH.UNU.KI.GAL = ki-bal-tum; and TU. vi, lxxv, i, (18) UNU.KI = ū-nu-uk-ū (19) ZA.SUH.KI = ū-nu-uk-ū (20) TIR.AN.NA.KI = TIR.AN.NA.KI-ū.
⁷ K. 240, iā₄ for ^aiā, putting ^aZA.SUH.SIG₇: . . . in same line.
⁸ From K. 240, iā₄-ni-bu bur-ru-mu(?), and evidently including next line at end of line.
⁹ K. 240 places this between ll. 34 and 35.
¹⁰ Re-exd. K. 240 adds: ^aTU.
¹¹ Re-exd.: perhaps šil.
¹² Form on CT. vi.
¹³ 'j' 68, [a].

182	<i>a</i> ŠAL.LA	<i>a</i> mul-ta-as-[pu(?)]	'sexual part of the she-ass' (belemnite?)
109	<i>a</i> bi-iš-šur a-ta-ni	<i>a</i> la-bi(-)išk(ia)-na-[tum] ²	
	<i>a</i> ŠA.ŠA.KALAG.GA		
113	<i>a</i> mu-šu NITA	<i>a</i> m[u]-[š]u [ša līb UŠ] ³	'male' misy (see l. 33)
113	<i>a</i> mu-šu ŠAL	<i>a</i> mu-šu [ša līb ŠAL] ³	'female' misy (see l. 33)
129, 132	<i>a</i> za-gi-in-du-ru-u	<i>a</i> [uknū?] ⁴	simple glaze (Appendix i, B)
133	<i>a</i> ši-ip-ru	<i>a</i> ZA.GIN.[AŠ]	sapphire
133	<i>a</i> ši-ip-ru	<i>a</i> ban ku-nu-[ku]	sapphire (the stone for making seals)
108	<i>a</i> EL	<i>a</i> ŠU.ER ⁵ . . .	'birth-stone', the stone in the geodes
108	<i>a</i> EL	<i>a</i> dr-sal-lu	"
108	[<i>a</i>]dr-sal-lu	<i>a</i> [, ?]	"
108	[<i>a</i>]dr-sal-lu	<i>a</i> it-ta-[mir]	"
108	[<i>a</i>]dr-sal-lu NITA	<i>a</i> " la da[mku]	male 'birth-stone' ('not soft')
108	[<i>a</i>]dr-sal-lu ŠAL	<i>a</i> " da[mku]	female 'birth-stone' ('soft')
111	[<i>a</i>]tar-na-ru	<i>a</i> sag-gi-li-m[ut]	'thunderbolt', nodule of iron sulphide
114	[<i>a</i>]HAR].ZABAR.NAM.MULU.GISGAL.LU	<i>a</i> ban līb bir-ki ameli	} misy, sulphate of copper or (and) iron (see l. 21)
114	(. . . [f]um ša ú-ru-ta-ti-šú	<i>a</i> ZA.SUH.DIR. ^a TU ⁶	
97	(. . . ia-ra-lu	<i>a</i> pap-pal-tum ša bir-ki ameli ⁶	colcothar, red vitriol
88	[<i>a</i>]it-in-du-u	<i>a</i> ban iškati	'fire-stone', iron pyrites
169	[<i>a</i>]BAR].GÜN.GÜN.NU	<i>a</i> EN.GI.ŠAG	'father of a stone' (= geodes)
192	[<i>a</i>]gu-ga-ru	<i>a</i> mal-ri-tum	(see p. 107)
107	[<i>a</i>]ša-a-bu	<i>a</i> a-bi ab-ni	case-tablet (geodes)
107	<i>e</i> -pi-ir-ru	"	(ear-ring)
107	<i>e</i> -rim-ma-tum	"	(ear-ring)
	lu-ul-mu-ú	<i>a</i> n-ša-ab-tum	mortar
	<i>a</i> -na-tum	im-bu- ² -u	pestle
	ši-ik-ka-tum	<i>a</i> ma-zuk-tum	
Int. § 15	ur-šu	<i>a</i> -mit-ti "	
Int. § 15	<i>e</i> -lit ur-šu		

¹ The mutilated text on K. 4232 reads apparently [*a*bi-iš]-šur šalatani (re-exd.). ² See p. 107.
 'B', n. 1. ³ From 'J' 60, 61: see

⁴ 'V' 14. ⁵ Re-exd.: possibly zu. See p. 108.

⁶ From K. 240: cf. l. 14.

'H' (cont.)

18	na-du-u NA.RŪ.A NA.RŪ.A NA.RŪ.A na-ru-u	na-du ša tiiti ši-tir šu-[mī] šu-mu zak-[ru] na-ru-[u] a-su-mit-[tum]	to 'throw' clay 'writing of a name' 'recorded name' 'tablet' stone memorial

50

'I'. K. 4218, A, r. v-vi (CT. xiv, 10), 19 ff.

		I	II	
Page				
88(?)	^a Šam ₄ -[š ₁] ¹	.....	.....	'sun-stone'(?), pyrites
88	^a pi-in-[du-u] ²	.....	.....	'fire-stone', iron pyrites
97(?)	^a ZA.SUH.[DIR(?)] ³	.....	.....	colcothar(?), red vitriol(?)
97(?)	^a ZA.SUH.[DIR(?)] ⁴	.....	.....	"
172	^a ba-ab-[ri-e] ⁴	.....	.....	red coral
167	^a KŪ.[BAL.E] ⁴	.....	.....	amethyst, corundum
182	^a GAR-Š[AG.GA] ⁴	.....	.....	agalmatolite
189	^a BALA[G.GA] ⁴	.....	.....	'drum-stone', pumice
	^a.....	.....	.....

¹ See 'A' 4, or 'J' 40, u₆-[ri-ia-lu].² See 'D' 13: 'H' 36.³ See 'H' 14 or 'J' 42, 43.⁴ See 'H' 3-8.

'J'. Mat. 88, 2, 40 ff.

Page	I	II	III
40	<i>a</i> ₁₆ ¹ -[r ¹]- <i>a-bu</i> <i>a</i> ₁₂ ² - <i>in-du-u</i> <i>a</i> ZA. SUH. UNU. KI <i>a</i> ZA. SUH. UNU. GAL <i>a</i> KALAG. GA <i>a</i> [KA. ŠAL]. LA ? <i>a</i> <i>abu</i> KA. ŠAL. LA 184 184 189 189 189 189 50	<i>a</i> ZA. SUH. DIR <i>a</i> AN. BIL <i>a</i> [ZA. S]UH <i>ar-ku</i> <i>a</i> . . . - <i>nu</i> ³ [<i>a</i> ₅]u- <i>ú</i> [<i>a</i> ₅]u- <i>ú</i> <i>a</i> <i>su-ú</i> <i>a</i> <i>su-ú</i> <i>a</i> ZID. IM <i>a</i> AŠ. MUR <i>a</i> AŠ. MUR <i>a</i> AŠ. MUR <i>a</i> UD. + ŠAL + KAB [<i>a</i> HAR]. HU. BA. ŠIR <i>a</i> [lam] <i>assi</i> <i>a</i> [ka]- <i>nu-u</i> <i>a</i> [ka]- <i>nu-u</i> <i>a</i> <i>mu</i> -[<i>su</i> (?)] <i>a</i> <i>mu-šu</i> <i>ka</i> <i>hb</i> UŠ <i>a</i> <i>mu-šu</i> <i>ka</i> <i>hb</i> [ŠAL] <i>a</i> <i>mal-ri-tu</i> <i>a</i> <i>uban</i> (?) <i>ša-sur-ri</i>	whetstone " " " pumice ('powder of clay') pumice 'powder of clay' 'powder of antimony' emery amethyst, corundum red coral agalmatolite 'barber's stone', 'pen-stone', pumice pumice, 'pen-stone' misy, sulphate of copper or (and) iron ⁵ male misy female misy 'birth-stone', stone in the geodes
55	<i>a</i> . . . - <i>ú</i> (?) [<i>a</i>] [<i>a</i> <i>mu-šu</i>] NITA <i>a</i> <i>mu-šu</i> ŠAL <i>a</i> <i>ši-gu-ga-ri</i> <i>a</i> EL 113 113 113 112 108		
60	<i>a</i> HU. SI (read <i>u</i> ₆). as text.		

¹ *a* HU. SI (read *u*₆).
as text.² Probably not *ši* as text.
³ See 'B', note 1.³ Reading uncertain: *a*[. . .]-*ma*(?)*-u-mu*.⁴ Probably not *du*

'J' (cont.)

	I	II	III
65	<i>a</i> EL <i>a</i> dr- <i>zal-lu</i> <i>a</i> dr- <i>zal-lu</i> NITA <i>a</i> dr- <i>zal-lu</i> ŠAL <i>a</i> BUR.ŠU.ŠAL.LA <i>a</i> ŠAL.LA <i>a</i> bi-š-šir ta-a-ni ⁴ <i>a</i> bi-š-šir ta-a-m ⁴ <i>a</i> BAR.GÜN.GÜN <i>a</i> PAR <i>a</i> ši-ip ⁵ -ru <i>a</i> <i>a</i> e-rim-ma-tú <i>a</i> ši-ka-a-tú <i>a</i> šim-ma-ia-tú	<i>a</i> epiš ir-r[i(?)] ¹ <i>aban</i> li[bbi(?)] <i>a</i> it-te-mir [la dam]ku <i>a</i> it-te-mir damku <i>a</i> bur-šá-si-[a] <i>a</i> mul-tas ² -p[u?] ³ .. <i>a</i> la-ši-ia- ... <i>a</i> ka-ba- ... <i>a</i> EN.GI.ŠAG <i>a</i> am-na-[ku?] <i>a</i> ZA.GÜN.DÚR(?) .. <i>a</i> nu-uk- ... ⁶ <i>a</i> ab [ab-mi] <i>a</i> im-bu-[-u <i>a</i> mu-šal-[tu]	'birth-stone', stone in the geodes " " " (not soft) 'birth-stone', stone in the geodes ('soft') 'sexual part of the she-ass' (belemnite?) white (stone), sand sapphire " 'case tablet', geodes sulphate of copper
70			
75			

¹ KAK ir-r[i(?)].² Read *tas* for *tu*, as 'H' 18?³ P[u(?)]⁴ Sic.⁵ Read *ip* for *ur*.⁶ For *ku-nu-uk*(?).

'K'. K. 4548 (CT. xiv, 17).

	Page	I	II	III
5		<p>.....¹ ^aKIŠIB².GUG ^aLAGAB².GUG ^aBIR².GUG ^aZA.TU ^aZA.ṬU.BE ^aZA.ṬU.IGI ^aZA.ṬU.PA.ḪU³.NA ^aZA].ṬU e-lal-lum⁴ ^aZA].ṬU ma-da]s-lum ^aZA.ṬU.MUŠ.GIR ^aZA.ṬU].IGI.MUŠ.GIR ^aZA.ṬU].PAR.AŠ ^aZA.ṬU].PAR.AŠ.AŠ ^aZA.ṬU.ID.ZA].SUḪ⁶</p>	<p>[d]i-ik-rum(?) (or mu?) hu-la-lu sa-a-su hu-la-lu i-ni šd kap-pi iš-šu-ri ŠU (= elallum) ŠU (= madallum) šir-gar-ru i-ni šir-gar-ri ŠU-u </p>	<p>white lead ('roasted white lead') red lead 'white lead for the eye' probably a yellowish limestone malachite Smaragdus Medicus calcite aragonite</p>
10				
15				

¹ Some form of red stone?

² Various objects made from ^aGUG; see CT. vi, 11; Scheil, RA. 1918, 115; TU. No. 36.

³ CT. vi, xi, 48, 49 a-la-lum and u-la-lum.

⁴ CT. vi, 11 gives (56) ^aKIŠIB.ZA.ṬU (57) ... ZA.ṬU (58) ... ZA.ṬU.

After this CT. vi, 11

⁵ Restored from CT. vi, 11, A 55.

	Page	I	II	III	IV
76	123	<i>gu-ug</i>	^a <i>GUG</i> (carnelian, &c.)	¹ <i>ia-sa-gu-la-ku</i>	(76-84) <i>sa-am</i> -[<i>tu</i>], <i>el</i> -[<i>u</i>], <i>ib-bu</i> <i>nam-ru</i> , . . ., <i>kak</i> (?)-[<i>ku</i>], <i>ka-ni</i> - [<i>ku</i>], <i>ka-na-ku ši-in-nu</i> (85-9) <i>uḫ-nu-ú</i> , <i>el-lu</i> , <i>ib-bu</i> , <i>nam-ru</i> , <i>sa-gi-in-nu</i>
85	129	<i>sa-gi-in</i>	^a <i>ZA. GĪN</i> (lapis)	¹ <i>ia-sa-ku-²ru-u</i>	
90	129	¹ , ² <i>-du-ru³</i>	^a <i>ZA. GĪN. DUR₅</i> (clear glaze)	----- ⁵ ¹ , ² <i>sa-ku-ur-a-a-ku</i>	(90-4) <i>sa-gi-in-du-ru-u</i> , <i>uḫ-nu-u</i> <i>el-lu</i> , <i>el-lu</i> , <i>ib-bu</i> , <i>nam-ru</i> <i>bu-¹la-lum</i>
95	135	<i>ni-ir</i>	^a <i>ZA. ṬU</i> (white lead)	⁴ , ⁵ <i>sa-a⁶-ṭu-na-ku</i>	"
96	135	<i>ni-ir</i>	^a <i>ZA. NIM</i> (white lead)	----- ⁷ ⁴ , ⁵ <i>sa-a-nim-ma-ku</i>	"
97	135	<i>ni-ir</i>	^a <i>ZA. SU</i> (= <i>KUS</i>) (white lead)	----- ⁸ ⁴ , ⁵ <i>sa-a-ku-šá-ku</i>	"
98		⁹ <i>ni-ir</i>	^a <i>ZA. DIB</i> (white lead)	<i>ia-sa-a-dib-ba-ku</i>	"
99	91	<i>šu-ba</i>	^a <i>ZA. SUḪ</i> (vitriol)	----- ¹⁰ ¹ , ² <i>sa-a-us-la-an-gu-nu-ku</i>	(99-100) <i>šu-bu-u</i> , <i>ra-am-ku</i> , <i>bi-it-¹¹</i> <i>ra-nu</i> , <i>el-lu</i> , <i>ib-bu</i> , <i>nam-ru</i> , <i>ṭi-lu</i> , <i>iluM[A(?)]</i> , <i>ba(?)</i> - , <i>iluNi(?)</i> . . . <i>ri-ē(?)</i> - . . .
110		⁹		. . . . .-<i>ku</i>	<i>su-um</i> (?)- . . .
111	94	<i>sa-ba-lam</i>	<i>ZA. SUḪ. UNU. KI</i> (green vitriol)	<i>sa-us-la-an-gu-nu- . . .</i>	
112	94	<i>pa-nu</i>	----- ¹³ <i>ZA. SUḪ. UNU. KI</i> (green vitriol)	" " " "	<i>ši(?)</i> -?

¹ From here to end of line in Col. iv from Meissner. ² CT. here . . . *ur* . . . ³ So Meissner: CT. *sa-gi-in-du-ur* ⁴ For this character Meissner's text has *ia*. ⁵ Meissner's text " *-a-a-ku*. ⁶ Meissner's text omits. ⁷ Meissner's text " *-tu(?)*-*ma-ku*. ⁸ Meissner's text " *-ku-šá-ku*. ⁹ Line wanting in CT. ¹⁰ Meissner's text " *-muš-la-an-gu-ru-u*. ¹¹ CT. *bit- . . .* ¹² Meissner's text *sa-muš-la-an-gu-nu-u-eš-gu-nu-ku*. ¹³ Meissner's text " . . .

'M'. K. 4330 (CT. xiv, 8: v R. 27, 4)

	Page	I	II	
10	46	ŠIM. ŠE. TU. GUŠKIN	šin-du [hu-ra-šu]	realgar
	46	ŠIM. GUŠKIN	ši-i-pu	realgar
	51	ŠIM. TAK. SAĦAR	ti-i-ru	orpiment (black arsenic)
	48	ŠIM. BI. ZI. DA	e-gu-ú	kohl
	47	[IM?]. SIG ₇ . SIG ₇	"	orpiment
15	48	ŠIM. BI. ZI. DA	a-ma-mu-ú	kohl
	47	ŠIM. BI. ZI. DA. SIG ₇ . S[IG ₇]	AS. HAR	orpiment
		IM. DA[RA]	[h]a-a-pu	(cf. p. 21)
	52	IM. GÜN. NU	a-[d]u-mat	orpiment
	46	IM. GUŠKIN	il-[lu-ar pa-ni]	realgar
20	20	IM. GÜ	ka-du-[tu]	mud, leaven
	20	IM. GÜ. EN. NA	" ši-ka-ni	leaven of dough set aside
	20	IM. GÜ. BI[?]. T[IN]. NA	" ši-ka-ri	yeast of beer
	35	IM. SAĦAR. GĪG. [KUR. RA]	[s]aḡ-mu	black alum

'N'. S. 550 (CT. xix, 11), perhaps part of K. 4381 'Q'.

	Page	I	II	
5		.....	.....	(cf. p. 47)
		IM. GÜN(DAR). A	.....	(cf. p. 21)
		IM. DARA	.....	(cf. p. 47)
		IM. GÜN(DAR). A	.....	orpiment
	47	IM. SIG ₇	da-[ma-tu]	orpiment
46	47	IM. SIG ₇ . SIG ₇	da-[ma-tu]	orpiment
	46	ŠIM. GUŠKIN	da-[ma-tu]	orpiment
	51	da-ma-tu	bur-[hu-ra-tu] ¹	

¹ See 'P' 28.

	Page	III	IV	
15	148	IM.PAR IM.DARA IM.DARA.RA UD.ḪUB.ŠU.ELTEG.A	[ga-aš-šu] [ha-a-pu] [me-e(?)]] ¹	gypsum, plaster (cf. p. 21)

¹ CT. xvi, 35, 23.

'P'. K. 4152 (CT. xiv, 45): K. 4140, b (ib. 43): cf. also K. 9160 (ib. 33). Cf. 'N'.

	Page	III	IV	
17	19	ŠIM. GUŠKIN ¹	šar-šêr-ru	ferric oxide
	19	ŠIM. DIR	šar-šêr-ru	ferric oxide
	19	ŠIM. GUG	šar-šêr-ru	ferric oxide
20	19	IM. DIR	šar-šê-ru	ferric oxide
	46	[ŠIM]. GUŠKIN	ši-i-pu	realgar
	47	[ŠIM]. BI. SIG ₇ . SIG ₇	ši-i-pu	orpiment
	46	[IM] ² . GUŠKIN	li-e-[ru]	realgar
	46	[ŠIM]. BI. GUŠKIN	li-e-[ru]	orpiment
25	47	[ŠIM]. SAḪAR	li-e-[ru]	orpiment
	47	[ŠIM]. BI. SIG ₇ . SIG ₇	da-ma-[tu]	realgar
	46	ŠIM. GUŠKIN	hur-ju-ra-[tu] ³	(cf. p. 51)
	51	da-ma-tum		

¹ From K. 9160.

² From CT. xix, 21, K. 4362, 32, 33, and 'Q' 17. K. 9160 has additions [ŠIM]. SAḪAR = ši-i-[pu], and [ŠIM]. BI. GUŠKIN = ši-i-[pu].

³ Meissner, AfSL., 1931, 190. See 'N' 8.

'Q'. K. 4381 (ii R. 30, 2, re-exd.: perhaps part of S. 550, 'N'): *Mat.* 34, r. 5.

III

II

I

Page

ŠU-¹
a-ma-mu-²

kohl

[ŠIM.BI].ZI.DA

48

[ŠIM.BI].ZI.DA

48

[ŠIM].BI.ZI.DA

48

[tus]-ka-a

49

[]-pa-a

49

[]-GAR.KÛ.DIM

49

[KÛ].ĤĖ

74

[lu]-lu-tú

74

[tu]s-ka-a

73

[tu]s-ka-a

73

ZID.URUDU.NI.KÛ.E

79

SÛ.UD.AG.GA

76

ŠIM.GUŠKIN

46

ŠIM.BI.SIG₇.SIG₇

47

IM.GUŠKIN

46

ŠIM.SAĤAR

47

ŠIM.BI.GUŠKIN

46

ŠIM.BI.GUŠKIN

46

ŠIM.BI.SIG₇.SIG₇

47

ŠIM.SAĤAR

47

ŠIM.SAĤAR.GUŠKIN

47

[ŠIM]

47

3 *Mat.* du(?)2 *Mat.* ú, adding as l. 3 -ma-mi-ú.1 *Mat.* [Šim-bi-si-du-ú.

Page	I	II	III
10	<p>...-ra-lu ...-ra-ds-tú [^u tus-k]a-a [^u KÚ].ĤĖ [^u ..GAR.KÚ].DÍM [^u ŠIM].BI.NAM(!) gam-gam-me</p>	<p>^ui-kur-a-ra ^upa-ra-ku(?)-tú ^uni-pi-iš erĭ ^ulu-lu-u ^uga-di-lu(!) ^ušu(!)-uĥ-tú(?)¹ ^uli(?)-i-rum(?) ^u "</p>	<p>placitis pompholyx kohl (chrysocolla) orpiment(?) orpiment(?)</p>
15	<p>[^u ŠIM].SAĤAR [^u ŠIM].GUŠKIN [^u ŠIM.BI].SIG₇.SIG₇ ^u " [^u] ŠIM.BI.ZI.DA ^u " ^u ..-ra(!)-a ^uŠÜ.UD.AG(?).(GÁ?) ^uIM.DARA ^u " ^uIM.DIR ^uIM.GUŠKIN ^uIM.GUG</p>	<p>^uli-i-rum ^uš-i-pu ^u " ^uda-ma-tú ^ušim-bi-si-du-u ^ugu-uly-lu ^u "(? ^uel-mu-[šú] ^uha-a-pu šar-še-rum ^u " ^u " ^u "</p>	<p>orpiment realgar orpiment orpiment kohl kohl kohl brass (c.f. p. 20) ferric oxide ^u " ^u " ^u "</p>
25			
30	<p>^uka-mun bi-ni ^usaĥ-ma ^ulu-ur-pa-du ^uan-nu-ĥa-ra</p>	<p>^uaga-bi-i ^u " ^u " ^u " ^u " GĜ GĜ</p>	<p>alum alum black alum black alum</p>

¹ This must surely be [ŠIM].BI.ZI = ^uku-uly-lu?

'S'. Mat. 33, 5, 1-36: v R. 27, 1.

	I	II	III
	..... ŠIM. GUŠKIN ŠIM. SAḤAR	..... [i-e-ru] li-e-[ru]	..... realgar see p. 48
5	IM. SAḤAR. PAR. KUR. RA IM. SAḤAR. GIG. KUR. RA IM. SAḤAR. TĀK. KUR. RA	a-nu-ḥa-r[u?] saḥ-mi a-ga-bu-ū	white alum black alum alum
10	IM. PAR IM. DARA IM. DIR IM. GŪN. GŪN. NŪ IM. SIG ₁ . SIG ₇	ga-aṣ-šu ḥa-a-ḥ[u] šā-ar-šer-ru ¹ ----- ¹ da-ma-a-t[ū] "----- ² il-lu-ru-ū ḥa-lu-ū ŠU -ku (= kalguḥku) ³ ḥa-du-tū ⁶ ----- ⁶ " šī-kin-nu " tam-tim? " na-a-ri kib-ri i-lu-nāri ru- ² -ut "	gypsum, plaster (cf. p. 21) ferric oxide orpiment orpiment realgar yellow ochre red ochre mud, leaven leaven of dough set aside deposit of the sea deposit of the river black sulphur yellow sulphur
15	IM. GUŠKIN IM. MAL IM. MAL. LI. GUG IM. GŪ IM. GŪ. EN. NA IM. GŪ. A. AB. BA IM. GŪ. ID. DA KI. A. AN. RU. GŪ UḤ. [AN. RU. GŪ]		
20			

¹ v R. [da]-ma-tum. ² v R. il-lu-ur pa-nu. ³ v R. kal-gu-uk-ku. ⁴ v R. ut-tum. ⁵ v R. has an additional line
IM. GŪ. TIN. NA = " šī-ka-ri. ⁶ v R. " šī-ka-ni. ⁷ v R. ti. ⁸ v R. adds ID. MULU. ⁹ v R. [UḤ. AN. ID.
MULU. RU. GŪ = nu-ut-tū i-lu-nāri.

'S' (cont.)

63	[A.LAL] ID.DA	ši-kin na-a-ri	'deposit of the river'
64	KA.A.AB.BA	im-bu-u tam-tim ²	AH.99.
67	URUDU	e-ru-ú	copper
67	URUDU.KALAG.GA	³ dan-nu	orichalcum (?)
70	URUDU.ZA.Rf ⁴ .IN	ŠU ⁵	orichalcum (?)
63	URUDU.ĦU.LAĦ.ĦA	kur-nu	'washed' copper
63	URUDU.SAĦAR. ⁸ LAL	me-su-ú	'what comes out of the mine'
63	URUDU.SAĦAR.ŠU	ši-ti hur-ri	
63	URUDU.SAĦAR.KI	ŠU-ku	
	URUDU.NI.TUK.KI	la-a-šú ⁹	
	¹¹ URUDU.NI.TUK.KI	"	
	URUDU.MÁ.GAN.NA	Dul-mu ¹⁰ -nu-ú	copper ingot (?)
	URUDU.ME.LUĦ.ĦA	As-nu-ú	copper ingot (?)
	URUDU.GAR.GID.DA	Ma-ak-ka-nu-ú	copper of Dilmun
		Me-luĦ-lu-ú	copper of Asnū
		ú-ra-ku	copper of Magan
			copper of Meluhha

From ii R. 48, 37, e. ² v R. ti. ³ v R. " . ⁴ So also v R. ⁵ v R. ŠU-nu (= *zarimu*). ⁶ Cf. CT. xiv. 8, bv. 22, URUDU.ZA . . . = [ku]r-nu. ⁷ Cf. ib. 23, URUDU SAĦAR . . . = [ši-ti]t hur-ri. ⁸ v R. ĦU.LAĦ.ĦA. v R. 'šú for a-šú. ¹⁰ v R. Dil-mu. ¹¹ v R. omits this line.

"T". K. 4400 (v R. 32, 1, l. 24 ff.); K. 4411 + 4602 + S. 21, (r. 5) r. 1 and K. 4547 + 7634 + 8388 + 11078 + 14134 + 14423 r. 6 ff. (Langdon, RA. 1931, 121). (Re-examined.)

	Page	I	II	III	
25	20	IM.GÚ.EN.NA	ka-dū-u ši-ka-ni	šik-nu ša nâri	leaven of dough, mud yeast of <i>kurumi</i> -beer mud, leaven orpiment, kohl kohl orpiment realgar orpiment (see p. 51) realgar (see p. 31) orpiment
	20	IM.GÚ.BI.TIN.NA	ka-dū-ut ši-ka-ri	šur-šum-nu ša kurumi	
	20	IM.GÚ	ka-dū-tum	di-du	
	47	IM.SIG ₇ .SIG ₇		gu-ub-lu	
	49	IM.ŠIM.BI.ZI.DA	a-ma-mi-ú	,, ¹ ša-di-du	
	47	IM.ŠIM.BI.ZI.DA. SIG ₇ .SIG ₇	AS.ĤAR	eš(sin)-ka-d-ru-ú	
30	47	IM.ŠIM.GUŠKIN	ši-i-pu	šin-di burasi	
	47	IM.ŠIM.TAK.SAĤAR	li-e-ru	šin-di šal-[m(?)]	
	46	IM.GUŠKIN	il-lu-ur pa-mi	ka-lu-[u]	
	47	IM.GÜN.NU	da-ma-[tu]	bur-b[u-ra-tu]	

¹ Only in K. 4400.

'V'. CT. xviii, 19, K. 4377 (v R. 29, 5)

Page	I	II	III
	.....	[<i>hu-ra-su</i>]	[gold] ¹
61	<i>mi-su</i>	"	"
61	<i>da-al-bu</i>	"	
61	<i>da-a-a-lum</i>	"	
59	<i>ša-ri-ri</i>	"	'the circulator'
61	<i>a-na-ku</i>	"	'lead', 'tin'
	<i>hi-bi-tum</i>	"	
61	<i>ŠAL.LA</i>	"	
61	<i>zu-u-zu</i>	"	(a coin)
61	<i>za-al-bu</i>	"	(in Shubarti)
129	<i>a-a-ra-ši</i>	"	(scaled?)
129	<i>ZA.GI.IN</i>	<i>SU.EDIN.KI</i>	
129	<i>ZA.GI.IN.DU.RU</i>	<i>uk-nu-[u]</i>	
133	<i>šip-ru</i>	"	
129	<i>ib-bu</i>	"	
	<i>š[i(?)]-i[n(?)-du(?)</i>	<i>šar-pu</i>	

¹ Note a fragment relating to gold, CT. xix, 6, K. 11187.

W. LT. 4, iv, 9 ff. (quoted previously by Meissner, *Beitr. z. Ass. Wörterb.*, ii, 68 (*Chic. Ass. Stud.*, i, iv)).

Page	I	II	
61	<i>ib-bu-um</i>	<i>GUŠKIN</i> ..	gold
61	<i>ša-aš-šu</i>	ditto	the red
61	<i>sa-a-nu</i>	ditto	'the red (?)'
59	<i>sa-ki-e-ru</i>	ditto	
	<i>ša-ri-ru</i>		
61	<i>KUBABBAR</i>	<i>ša-ar-ṣu</i>	silver
81	<i>ši-ṣa-tu</i>	<i>ba-bal-[kin(?)-nu]</i>	steel (?)
	<i>AN.KAL</i>	<i>an-šu(?)</i>	

K. 14053 (*CT* xiv, 31): cf. K. 4588 (*ib.* 32), and Meissner, *MVAG.*, 1904, 31, and *Beitr.* ii, 35. The latter gains a quotation from a tablet also copied by Herr Pick, which Herr Professor Ehelolf has been so good as allow me to quote, a permission which I gratefully acknowledge. This latter tablet belongs to the series *I.AN.NA* = ⁴*malakal*.

Page	I	II	
1-ku ¹	common salt
5	.....	uMUN
	MUN.a-ma-nim	uMUN.a-ma-ni ¹	
5	MUN.a-ma-ni ²	----- ³	'red salt' common salt, with impurities common salt, with impurities <i>sal gemma</i> (?) <i>sal gemma</i> (?) borax (?) bread borax (?) lye (?)
3	MUN.EME.ŠAL.LIM	uMUN.šamtu(tu) ¹	
3	MUN.MULU ⁵ .GISGAL.LU	uMUN.šadê(e) ⁴	
5	MUN.KÛ.GA	uMUN.šadê(e)	
5	MUN.US	uMUN.šadê(e)	
14	MUN.IN.TU.RA	uMUN.ba-ri-ka-ti ⁵	
15	MUN.KÛ.PAD	uMUN.KÛ.PAD inamûnu Akkadiki	
14	[MUN bu(?)]-u(?) ⁶ -ri	uMUN bu-[u-ri] ⁶	
	...UD	u	
15	...-[m]a(?) ⁷ -nu?	.....⁶

From K. 4588. ² *Beitr. nim.* ³ *Beitr. sa-an-ti.* ⁴ K. 4588 apparently simply [⁴]MUN. ⁵ Restored from *CT*. xvii, 26, l. 15. ⁶ Line not on *Beitr.* tablet. ⁷ Herr Pick's copy gives MUN ma-a-nu = MUN e-⁷(?)⁷-ri.

'Y'. Omen tablet from CT. xxxviii, 9, Tablet iii.

Enuna giš-ši-ma-ru zi-kép giš. ? ..

Enuna hurošu ...

Enuna anâku ...

Enuna A.GUG ...

5 *Enuna KÛ.PAD.DU.UŠ ...*

Enuna KÛ.PAD.DU siparri ..

Enuna IM.PAR ŠI] ...

Enuna IM.DIR ŠI] ...

Enuna ^aAD.BAR ŠI] ...

10 *Enuna ^aBI.LA ŠI ...*

Enuna BUR.TAG ŠI ...

Enuna TAG.GAZ ŠI ...

Enuna ^asântu ŠI ...

Enuna kibir iluqâri ŠI ...

(Remainder on obverse are vegetables.)

ABBREVIATIONS

'A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K', 'L', 'M', 'N', 'O', 'P', 'Q', 'R', 'S', 'T', 'U', 'V', 'W', 'X', 'Y', see the Cuneiform Syllabaries of Minerals, pp. 200-228.

- A. W. Ainsworth, *Researches in Assyria, Babylonia, and Chaldaea*.
 AAA. *Annals of Archaeology and Anthropology*, Liverpool.
 ABL. R. F. Harper, *Assyrian and Babylonian Letters*.
 AD. G. Smith, *Assyrian Discoveries*.
 ADD. C. H. W. Johns, *Assyrian Deeds and Documents*.
 AE. *Ancient Egypt and the East*.
 AEM. A. Lucas, *Ancient Egyptian Materials*.
 AEMI. A. Lucas, *Ancient Egyptian Materials and Industries*.
 AF. B. Meissner, *Altorientalische Forschungen*.
 AG. H. Blancourt, *The Art of Glass* (1699).
 AH. R. Campbell Thompson, *The Assyrian Herbal*.
 AHM. J. F. Royle, *Antient Hindoo Medicine*.
 AIK. read IAK on p. 150.
 AJ. *The Antiquaries Journal*.
 AJPhil. *The American Journal of Philology*.
 AJSL. *The American Journal of Semitic Languages*.
 AKA. L. W. King, *Annals of the Kings of Assyria*.
 AKSAW. *Abh. d. Kgl. Sächs. Akad. d. Wiss., philol.-hist. Kl.*
 AL³. F. Delitzsch, *Assyrische Lesestücke*, 3rd Aufl.
 AM. R. Campbell Thompson, *Assyrian Medical Texts*.
 AMaI. E. Herzfeld, *Archäol. Mitteil. aus Iran*.
 Am(enophis).
Ancient Min(eralogy), by N. F. Moore.
 Anp. Ashurnasirpal.
 AO. *Der alte Orient*, hrsg. von der Vorderas. Gesellsch.
 AOF. H. Winckler, *Altorientalische Forschungen*.
 AOTU. (ed. B. Meissner) *Altorientalische Texte und Untersuchungen*.
 AR. D. D. Luckenbill, *Ancient Records, Assyria and Babylonia*.
 Arch. *Archaeologia*.
 Asb. Ashurbanipal (for publication of his texts see M. Streck, *Assur-bampal*).
 AT. T. G. Pinches, *The Amherst Tablets*.
 AV. J. N. Strassmaier, *Alphabetisches Verzeichnis*.
 BA. *Beiträge zur Assyriologie*.
 Bab. *Babyloniaca*.
 Bab.-Ass. B. Meissner, *Babylonien und Assyrien*.
 Bab. Misc. F. H. Weissbach, *Babylonische Miscellen*.
 BAG. C. Bezold, *Babylonisch-Assyrisches Glossar*.
 BBR. H. Zimmern, *Beiträge zur Kenntnis der Babylonischen Religion*.
 BE. *The Babylonian Expedition of the Univ. of Pennsylvania*.
 BMM. R. N. Khory, *Bombay Materia Medica*.
 Br. R. Brünnow, *A Classified List of Cuneiform Ideographs*.
 BRP. T. Clay, *Babylonian Records in the Library of J. Pierpont Morgan*.
 BS. B. Meissner-P. Rost, *Die Bauinschriften Sanheribs*.
 CAH. *The Cambridge Ancient History*.

ABBREVIATIONS

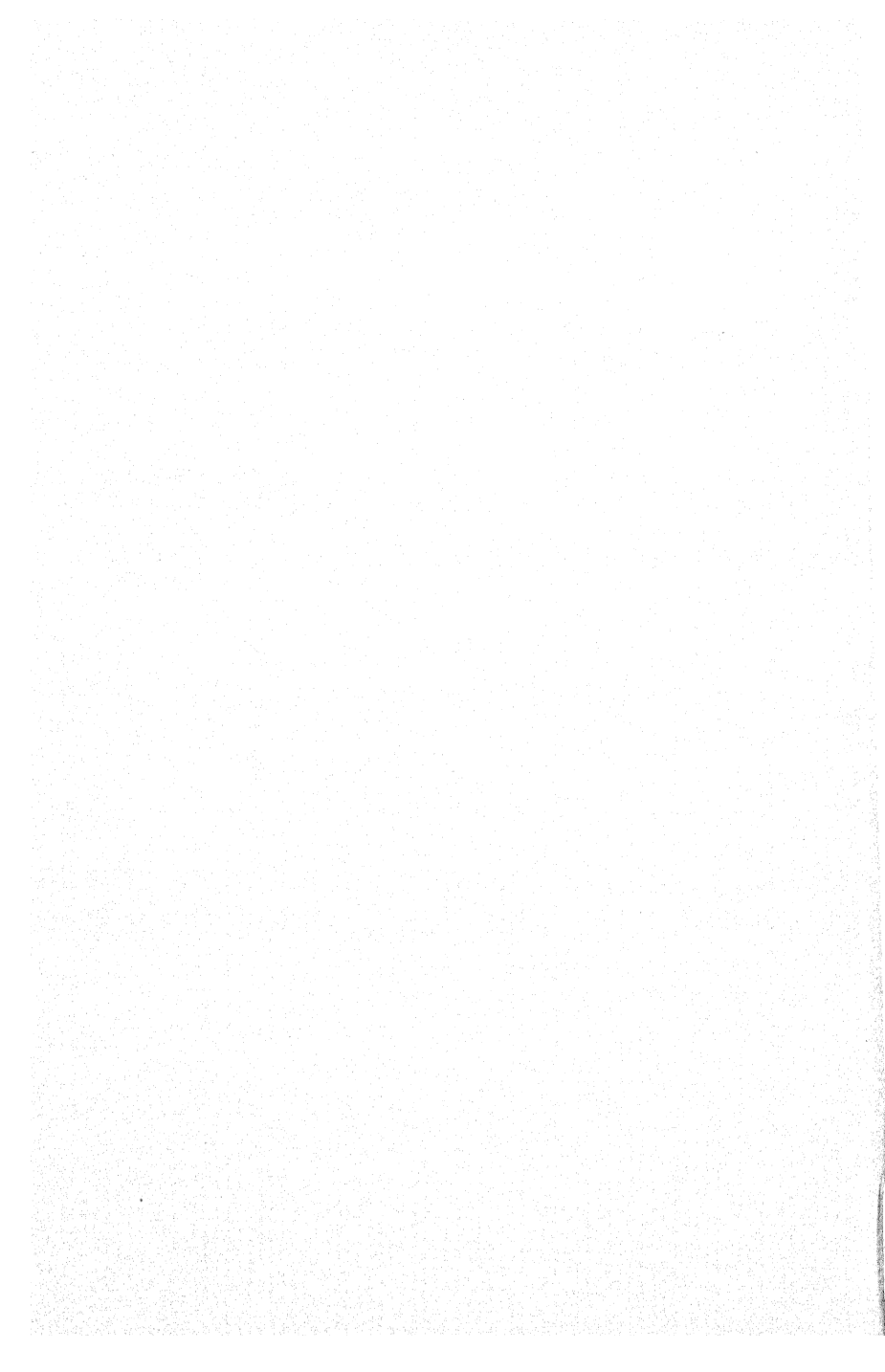
- at. C. Bezold, *Catalogue of the Cuneiform Tablets in the K. Collection*:
L. W. King, Supplement to the above: L. Delaporte, *Catalogue des cylindres orientaux*: L. Heuzey, *Catalogue des figurines*.
- BB. R. Campbell Thompson, *A Catalogue of the late Babylonian Tablets in the Bodleian Library*.
- C. P. van der Meer, *Une Correspondance commerciale*.
- CT. *Cuneiform Texts from Cappadocian Tablets in the British Museum*.
- amic Tech(nology), by C. F. Binns.
- voix de Textes relatifs à la divination) (A. Boissier).
- lection des Anciens Alchimistes Grecs), by M. Berthelot.
- PI. G. Watt, *Commercial Products of India*.
- S. K. C. Bailey, *The Elder Pliny's Chapters on Chemical Subjects*.
- T. *Cuneiform Texts from Babylonian Tablets, &c., in the British Museum*.
- r. J. N. Strassmaier, *Inschriften von Cyrus*.
A. Deimel, *Sumerisches Lexicon*.
4. A. Boissier, *Documents assyriens relatifs aux présages*.
- r. J. N. Strassmaier, *Inschriften von Darius I*.
- 4C. E. Thorpe, *Dictionary of Applied Chemistry*, 1913.
- 4P. Read DAC on p. 185.
3. *Dictionary of the Bible*. ((1) J. Hastings, (2) William Smith).
2. C. Rawson, *Dictionary of Dyes*.
- IS. R. Campbell Thompson, *The Devils and Evil Spirits of Babylonia*.
- Dillon, *Glass*.
4. R. Quain, *Dictionary of Medicine*, 1883.
- sc(orides).
4. G. Rodwell, *Dictionary of Science*.
E. Ebeling, in *Archiv f. Geschichte d. Medizin*.
- A. E. O. von Lippmann, *Entstehung und Ausbreitung der Alchemie*.
Encyclopaedia Britannica.
J. C. Booth, *Encyclopaedia of Chemistry*.
W. Ainsworth, *Euphrates Expedition*.
- A. Sidney Smith, *Early History of Assyria*.
- I. East India House Inscription, 1 R. 53.
F. Rutley, *Elements of Mineralogy*.
- rh. Esarhaddon.
- R. F. R. Chesney, *Expedition for the Survey of the Rivers Euphrates and Tigris*.
see ESR.
G. G. Boson, *Les Métaux et les Pierres*.
Geology of Mesopotamia (issued by the Admiralty Staff).
R. Campbell Thompson, *The Gilgamesh Epic*.
F. Hrozný, *Das Getreide im alten Babylonien*.
- s-texts. See Appendix I.
- Hardness.
- See ABL.
- (1) F. Thureau-Dangin, *Une Relation de la 8me campagne de Sargon*: (2) F. Hoefer, *Histoire de la chimie*.
J. Campbell Brown, *History of Chemistry*.
Pomet, *History of Druggs*.
L. Legrain, *Historical Fragments*.
J. Beckmann, *History of Inventions*.
M. Berthelot, *Histoire des sciences*.

- H.N.** Used in quotation, p. 92, for NH.
- HRET.** C. E. Keiser, *Historical, Religious, and Economic Texts*.
- HS.** (1) M. Berthelot, *Histoire des sciences*.
(2) W. C. Dampier, *A History of Science*.
- HWB.** F. Delitzsch, *Assyrisches Handwörterbuch*.
- IA.** T. Bauer, *Das Inschriftenwerk Assurbanipals*.
- IAK.** Ebeling-Meissner-Weidner, *Inschriften der altassyrischen Könige*.
- IB.** Ibn Beithar, in Leclerc, *Notices des manuscrits*, xxiii, xxv, xxvi.
- ISA.** F. Thureau-Dangin, *Les Inscriptions de Sumer et d'Akkad*.
- It.** G. G. Boson, *I Metalli e le Pietre*, *Rivista d. Studi Orientali*, 1916, vii, 379.
- ITT.** F. Thureau-Dangin, *Inventaire des Tablettes de Tello*.
- JA.** *Journal Asiatique*.
- JEAL.** *The Journal of Egyptian Archaeology*.
- JRAI.** *The Journal of the Royal Anthropological Institute*.
- JRAS.** *The Journal of the Royal Asiatic Society*.
- JSOR.** *The Journal of the Society of Oriental Research*.
- K.** H. Holma, *Die Namen der Körperteile*.
- KAH.** *Keilschrifttexte aus Assur, Historischen Inhalts*.
- KAR.** *Keilschrifttexte aus Assur, Religiösen Inhalts*.
- KAT³.** E. Schrader, *Die Keilinschriften und das Alte Testament*, 3. Aufl.
- KAVI.** *Keilschrifttexte aus Assur, verschiedenen Inhalts*.
- KB.** *Keilinschriftliche Bibliothek*, ed. Schrader.
- Keils. Sarg.** H. Winckler, *Die Keilschrifttexte Sargons*.
- KK.** (1) B. Landsberger, *Der Kultische Kalender*, *Leipziger Sem. Stud.* vi, 1.
(2) J. Lewy, *Die Keilschrifttexte aus Kleinasien*.
- Koord(istan),** by C. J. Rich.
- KS.** M. Witzel, *Keilinschriftliche Studien*.
- KTb.** *Keilschrifttexte aus Boghazköi*.
- KTS.** J. Lewy, *Kultepe Text der Sammlung Hahn*.
- Kü.** F. Kückler, *Beitr. z. Kenntnis d. Assyrisch-Babyl. Medizin*: i, K. 191: ii, K. 71, b: iii, K. 61.
- KUB., KuB.** *Keilschrifturkunden aus Boghazköi*.
- LBB.** R. Campbell Thompson, *Late Babylonian Letters*.
- LK.** A. Falkenstein, *Literarische Keilschrifttexte*.
- LT.** (1) L. Matoush, (2) W. Von Soden, *Die lexikalischen Tafelserien der Babylonier und Assyrier*.
- Luck.** D. D. Luckenbill, *The Annals of Sennacherib*.
- LZ.** E. Ebeling, *Liebeszauber im alten Orient* (MDAG. 1).
- MA.** W. Muss-Arnolt, *A Concise Dictionary of the Assyrian Language*.
- MAE.** V. G. Childe, *The Most Ancient East*.
- MAM.** T. A. Rickard, *Man and Metals*.
- MANB.** R. Campbell Thompson, *The Reports of the Magicians and Astrologers*.
- MAOG.** *Mitteil. d. Altor. Gesellschaft*.
- MASB.** H. E. Stapleton, *Chemistry in 'Irāq* (*Memoirs of the Asiatic Society of Bengal*, viii, 1927, 317).
- Mat.** L. Matoush, *Die lexikalischen Tafelserien der Babylonier und Assyrier*.
- MDA(O)G.** *Mitteil. d. Altor. Gesellschaft*.
- MGI.** T. H. Holland, *Manual of the Geology of India*.
- MGSI.** *Memoirs of the Geological Society of India*.

- MM. Read *MI*.
 MMAP. *Mémoires de la Mission Archéologique de Perse*.
 Mod. Modern.
 MVAG. *Mitteil. d. Vorderas. Gesellschaft*.
 Narr. F. R. Chesney, *Narrative of the Euphrates Expedition*.
 NB. E. Ebeling, *Neubabylonische Briefe aus Uruk*.
 Nbk. J. N. Strassmaier, *Inschriften von Nebukadnezar*.
 Nbn. J. N. Strassmaier, *Inschriften von Nabonidus*.
 A.Neri ed. C. Merrett, *The Art of Glass*, 1662.
 NH. Pliny, *Natural History* (ed. Bostock).
 Nim(eveh). By A. H. Layard.
 Nin. (and) Bab. A. H. Layard, *Nineveh and Babylon*.
 NK. S. Langdon, *Neubabylonische Königsinschriften*.
 NR. A. H. Layard, *Nineveh and its Remains*.
 NRV. M. San Nicolò and Ungnad, *Neubab. Rechts- u. Verwaltungsurkunden*.
 ODAC. J. R. Partington, *Origins and Development of Applied Chemistry*.
 OLZ. *Orientalistische Literaturzeitung*.
 OT. Old Testament.
 OTC. R. Campbell Thompson, *On the Chemistry of the Ancient Assyrians*.
 P. P. W. Squire's *Companion to the British Pharmacopoeia*, 18th ed.
 PBS. *Publications of the Babylonian Section of the Univ. of Pennsylvania* (vol. xii, i, vii is 'G' on p. 209).
 PC. *The Penny Cyclopaedia*.
 PE. R. Campbell Thompson, *The Prisms of Esarhaddon and Ashurbanipal*.
 Pellatt Apsley Pellatt, *Curiosities of Glass Making*.
 PRSM. *Proceedings of the Royal Society of Medicine*.
 PS. E. W. Streeter, *Precious Stones and Gems*, 5th ed.
 PSBA. *Proceedings of the Society of Biblical Archaeology*.
 PSG. C. W. King, *Precious Stones and Gems*.
 PST. R. Payne Smith, *Thesaurus Syriacus*.
 R. H. C. Rawlinson, *The Cuneiform Inscriptions of Western Asia*, vols. i-v.
 RA. *Revue d'Assyriologie*.
 Re-exd. 'Re-examined', generally referring to a collation of the original tablet.
 Rit. Acc. F. Thureau-Dangin, *Rituels Accadiens*.
 RTC. F. Thureau-Dangin, *Recueil de tablettes chaldéennes*.
 RUL. E. M. Grice, *Records from Ur and Larsa*.
 Rutley See *EM*.
 SAI. B. Meissner, *Seltene Assyrische Ideogramme*.
 SBH. G. A. Reisner, *Sum.-bab. Hymnen*.
 SC. W. Hayes Ward, *Seal Cylinders of Western Asia*.
 SEC. J. M. Stillman, *The Story of Early Chemistry*.
 Senn(acherib) (ed. Luckenbill; see *Luck*).
 Shalm(aneser).
 SLT. E. Chiera, *Sumerian Lexical Texts*.
 SM. E. A. W. Budge, *Syriac Medicine*.
 SMR. T. H. Holland, *Sketch of the Mineral Resources of India*.
 Streck M. Streck, *Assurbanipal*.
 TA. J. A. Knudtzon, *Die El-Amarna Tafeln (Vorderasiatische Bibliothek)*.

TD.	H. de Genouillac, <i>Tablettes de Drehem</i> .
TE.	H. de Genouillac, <i>Textes économiques d'Oumma</i> .
Tigl(ath Pileser).	
TIM(M).	<i>Transactions of the Institute of Mining Engineers</i> .
TL.	E. Ebeling, <i>Tod und Leben</i> .
TP.I.	W. Lotz, <i>Die Inschr. Tiglath-Pileser I</i> .
TP.III.	Tiglath-Pileser III.
Tr(avel)s.	W. Ainsworth, <i>Travels and Researches in Asia Minor</i> .
TSBA.	<i>Transactions of the Society of Biblical Archaeology</i> .
TTC.	G. Contenau, <i>Trente tablettes cappadociennes</i> .
TU.	F. Thureau-Dangin, <i>Tablettes d'Uruk</i> .
TUrk.	G. Reisner, <i>Tempelurkunden aus Telloh</i> .
UE.	L. Woolley, <i>Ur Excavations</i> .
UMBS.	<i>University Museum of Pennsylvania, Bab. Section</i> .
unk.	unknown.
UP.	G. A. Barton (UMBS. ix, 1), <i>Sumerian Business and Administrative Documents</i> .
VK.	William Rhind, <i>A History of the Vegetable Kingdom</i> .
WM.	L. J. Spencer, <i>The World's Minerals</i> .
YOS.	<i>Yale Oriental Series</i> .
YT.	W. W. Smyth, <i>A Year with the Turks</i> .
ZA.	<i>Zeitschrift für Assyriologie</i> .
ZDMG.	<i>Zeitschrift der Deutschen Morgenländ. Gesellschaft</i> .
ZK.	<i>Zeitschrift für Keilschriftforschung</i> .

(Reference is made to my unpublished copies of a few Kouyunjik Tablets in the British Museum.)



INDEX¹ I

ENGLISH

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¹ References to occurrences of words in the vocabularies ('A' to 'Y', pp. 200-28) are omitted in this index if they have already been included on the page first quoted. If the reference is to a mineral which is discussed at length, the

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¹ See Wainwright, *Antiquity*, March 1936, 5, *The Coming of Iron*.
² Also found at Mohenjo Daro (see *ODAC*. 214).

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aban ilu Anim, stone of Anu, 170.

aban ašakki, calculus (?), 171.

aban billi, *unk.*, 174.

aban birki ameli, *see aban lib birki ameli*.

aban dāme, salt, 1, 5.

aban elligi, 'barber's stone', pumice, 189.

¹ It should have been added that this Wadi under the name *Tartara* occurs in the inscriptions of Tukulti-Ninurta II (Scheil, *Annales*), and any connexion with *šaršerru* can only be made by assuming that *Tartara* is an Arabic or Aramaic form.

aban eri, geodes, 105.
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aban kašari, 'rubbing-stone', pumice, 189, xlvī, 163.
aban kīsi, 'A' 6.
aban kisusi, 'rubbing-stone', whetstone, 184.
aban kitti, 'stone of truth', 'A' 5.
aban kaṇū, 'reed(-pen)-stone', pumice, 189, 176.
aban kīlli (*kīlla*), 'bird's-eye stone' (sling stone?), 169.
aban la eri, 'stone of not conceiving', 108.
aban (*h*b) *birki ameli*, see *mušūl*.
aban marti, 'gall-stone', 183.
aban $\frac{1}{2}$ (*mišūl*) *mana*, 'A' 9.
aban nisiḫti, 'precious stone', 91.
aban nūni, 'fish-stone', a blue stone (?), 183.
aban rēmi, 'love-stone', 188.
aban suluppi, date stone, 186.
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aban šamē, hail-stone, xxxvi.
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A. BĀR, *abaru*, *A. GUG*, lead, *somett*. antimony (?), 116 ff.: in glass, xxxii, xxxv, 151, 197. See *LIŠ. A. BĀR*.
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abnu, stone, mineral, hail (coal), xxxvi: the 'melt', xxvii, xxxvi.
abnu ešrū, talc (?), 180.
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abnu ša aškapi, 'stone of the leather-dresser', xlv.
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abukatu, a gum (from the *andropogon* (?)), 11.
A. DAN. URUDU, 'copper gum', *prob.* chrysocolla, 70, 63: (*A. DAN* *ša₁₀ URUDU*, 197).

aAD. BAR, basalt, lava, pumice, 160, xxxix, 158.
aadbaru (as above).
a[d]umatu, 'red-brown', orpiment, 47, 52.
adumatu, opium, xvii.
A. EN. DA, *unk.*, 79.
A. GAR. GAR, dung of graminivorous animal, 41.
A. GAR. GAR. AN. ID, bitumen, 41: *ḫašabti nāri* (?), 28, 43.
A. GEŠTIN. NA, vinegar, 136, xx.
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aAG. GA, *unk.*, 188.
aḫu(s)su, glaze, xxviii, 194 ff.
aḫar ili, chameleon, 169.
aiaṛtu, white coral (?), 165.
airahi, 'gold in Shubarti', 61, 97.
aklu, soot, sublimate, *esp.* chloride of ammonia, sal ammoniac, 23 ff.
aḫāsu, to prick, smart, 114.
alaldu, mistake for *alallu*, 159.
[A. LA]L. ID. DA = *šikin nāri*, deposit of the river, 22.
alallu, roller (-bird), xviii.
aalallu, a form of (yellow (?)) limestone, 159, 158.
AL. DI. URU. GA-bird, 1.
algamišu, corundum, emery, amethyst, 167 ff., xlvī, 134.
alīkam, 'growing', of flesh, 53.
AL. UŠ. SA, a fluid with a strong smell (see *Babyl.* xiv, 124: *RA.* 1929, 49).
amamū, a form of *koḫl*, or arsenic, 51, 49.
amanu (connected with salt), 5.
amaru, asphalt, 43.
amittu, pestle, xlv.
amitti ḫarubi, 98 (see *Babyl.* xiv, 106).
amna(k)ku, white silicious sand for glass, 36, 142.
a(n)naku, tin, sometimes lead, 121, xxxii: gold, 61.
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AN. BAR, iron, 80: male, 81.
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^(a)*AN. NE*, saltpetre, 8, xxxv, 1, 197: — *GIG*, black, 9: — —, male and female, 9: — *PAR*, white, 9.

(a. ⁴¹) *a(n)nuhara*, black alum, 34: white alum, 34.
anšabtum, 'H' 42.
^a*AN.ŠE.TIR*, garnet (?) matrix containing garnet (?), 163, 88, 103, 158.
AN.ŠI.ĦUŠ, 89.
an-šu (?), 'W' 16.
AN.TA.ŠUR.RA, red gold, 59.
^a*apašnu*, see *abarummu*.
maškuapi, hide coverings for fuel, xxvi.
argamānu, red-purple, 12, 130.
arḫu, scale (of copper), 97, 61, 68.
arḫu, gold, 61: yellow, xxxviii.
armanu, apricot, xlv.
^a*ARRUŠ* (= *aban rêmi*, 'love-stone'), 188.
^a*arzallu*, stone contained in geodes, 108: male and female, 109.
^a*AS.ĦAR*, lamellar arsenic, 52, 57, 49.
^a*aspū*, jasper, 170.
asumittu, 'H' 51.
^a*AŠ*, *asa foetida*, 55 ff., xlv.
AŠ, *AŠ.AŠ*, 'hard', 'very hard', in scale of hardness of stones, 133.
AŠ-su, = *tašamid-su* (?), 187.
ašakku (*asakku*), demon (represented by bitumen), 42, 149.
^a*ašakku*, calculus (?), 171.
^a*AŠ.GE₄.GE₄*, native arsenic, 54, xx, xxxi, 195.
ašgikū, native arsenic, 54.
aškiḫū, native arsenic, 54.
^a*AŠ.MUR*, smiris, emery, &c., 167, xxi, xlv, 8, 52, 134.
ašnan, corn, xxxviii.
^a*ašnan*, garnet (?), matrix of garnet (?), 163, 158.
^a*ašpū*, jasper, 170.
aššaku, opaque, 72 ff., 195.
^a*AŠ.ŠIR.GAL*, alabaster (?), 147.
aš[tu] (*IM.KAL*), (in connexion with 'sublimate'), 24.
^a*A.TU.GAB.LIŠ*, xxviii.
^a*A.ZAL.LA*, ^a*azallū*, *cannabis*, hemp, xvii ff., xli.
azupirānu, saffron, xlv.
BA.BA.ZA.AN.ĪD, gypsum, esp. of the Euphrates, 43: written *ba-ba-za I.TI*, *AM.* 70, 7, ii, 5.
bāb kūrī, door of the furnace, xxv.

^a*DINGIR.BABBAR*, 'Sun-stone', pyrites (?), 88.
baḥāšu, to agitate, xxvii, 68.
^a*baḥrē*, red coral, 172, xxxi ff., 73, 195.
baḥru, fuming, steaming, 102.
^a*BAL*, belemnite (?), 186.
^a*BALAG.GA*, 'drum-stone', pumice, 189 ff., 52.
balālu, ii, 1: to mix, melt, xxvii.
ballu, fodder, xviii.
ambappiru, apothecary (?), 177.
^a*BAR.GÜN.GÜN.NU* (*NU*), *unk.*, perhaps a stone changing colour in the sun, 169.
BAR.GÜN.GÜN.NU.KUR.RA, chameleon, 169.
barraḫtu, emerald (?), 174, xlv.
basili, xlii.
baššu, sand, 36.
^a*ba-aš*(?) - . . ., xxxi, 195.
bašamu, spices, xxiii.
(bašālu), of stones, cf. xlv: of gypsum, 150.
BE-ir = *tesikḫir*, 137.
belu, sling stone, 111.
bēru, two-hour period, xlv.
^a*bidanam*, *unk.*, 172.
^a*bidnam*, *unk.*, 172.
^a*BIL*, fire-stone, pyrites, 88.
^a*BI.LA*, *unk.*, 174.
BIL.LAL, vinegar, xx, 136.
^a*BIL.LI*, *unk.*, 174.
billu, the 'melt', xxvii.
(BIR), lime (see *ZALAG*).
birbirānu = *taslami igari*, 12.
^a*BIR.GUG*, 'K' 5.
^a*BIR.KA.GI.NA* = *tukpit[um]*, 82.
birāti, see *abnē birāti*, turquoise (?).
^a*BIR.ZA.ṬU*, 135.
^a*biššir tāni*, see ^a*biššur atani*.
^a*biššur atani*, belemnite (?), 109.
bīt kūrī, 'house of the furnace', xxiv.
bitrānu, a word for a vitriol, 91.
bullū, to wear out, xxxvii.
bullulu, to melt, mix, 117.
^a*burallu*, beryl, 174, xlv.
burašu, pine, xlv.
^a*BUR marḫallum*, 103.
^a*BUR marḫušum*, 103 ff.
burru algamiši, 168.
burrumu, to twist, weave, xviii.
^a*buršašil[a]*, *unk.*, 175.
^a*BUR.ŠU.ŠAL.LA*, *unk.*, 175.
BUR.TAG, 'Y' 11.

^aBUR.UD+ŠAL+KAB, 168.
burumu, variegated (or dark blue?), 95:
cf. xvii.

buši, a wood (charcoal?), 75.
bušu (širšu), bat, xviii.

da'ābu, to agitate (?), xxvii, 69.

daialum, gold, 61.

^adaiku (abortifacient), 108.

dakkannu, arch, xxv.

dalbu, gold, 61.

dallu = Arab. *delleh* (?), 131.

damatu, orpiment, 47 ff.: in glass, 101,
195.

dāmi širi šalmi, 'blood of a black snake'
= castor oil, xiii.

danitu, adhesive (?), 76.

dannu (IM.KAL(AG).GA), in con-
nexion with 'sublimate', 24.

didu = tiṭu, clay, 20.

digmen ^uuḫuli, ash from alkali-plant,
14 ff.

digminu ša ^uuḫuli ḫarnani, ash from
salicornia alkali, 15.

digmeni ša dukkan, 'ash of the (furnace)
dome', xxv.

digmenu ša išarbatu, 'ash of styrax',
xxviii.

dikrum (or dikmu?), 'K' 2.

dikari algamiši, 168.

Dilmunū-copper, 65.

^uDIR, 'red drug', 30.

DUB, verdigris, 63, 71.

^aDUB elili (read ^aKIŠIB elili), seal of
(yellow?) limestone, 159.

^aDUB.BA.AN, unk., 163, 175.

dukkannu, arch, xxv.

duḫḫuku, to powder small, 28.

duktu, mortar (or pestle) for uḫnū, 131.

^aDUR.KIB (?), unk., 175.

^aDU₈.ŠI.A, see ^adušū.

^adušū, crystal, glass, xxviii, 175, 139,
195: — arḫu, green crystal, xxxi,
195.

^adušū Marḫaši, crystal of Marḫaši,
100.

^adušū Paraši, crystal of Paraši, 100.

^aDŪ.ŠUB.BA, probably alum-
stone, alunite, 176, 1.

egū, a form of arsenic, 49.

egū ša ekī, a collyrium, 50.

^aE.GŪ.ZAG.GĀ, golden 'sapphire',
spangled lapis, 133.

^aEL, stone contained in the geodes,
108, 144.

^aelallu, a form of (yellow?) limestone,
158.

^aE.LAL.LU, a form of (yellow?)
limestone, 159.

elamete, discovery (?), xxxiv, xxxv.

^aE.LI.EL, a form of (yellow?) lime-
stone, 159.

^aelili, a form of (yellow?) limestone,
159.

elit (ilit) urši, elit (ilit) mazukti (pestle),
xliv, 103.

elligu, barber, 191.

^uelmeštu, *hyoscyamus niger*, L., 78.

elmešu, elmušu, brass, 71, 75 ff.: p.n.,
78.

^uELTEG (see ^uuḫulu), vegetable alkali,
1, 15.

^aELTEG (see ^aadbaru), basalt, lava,
pumice, 158, 160.

^uELTEG.SI (^uuḫulu ḫarnanu), alkali
from the salicornia, 15.

^aelu (?), unk., 167.

EMEDUB, verdigris, 71, 63.

emēšu, to crush, 149.

^aEN.GI.ŠĀG, unk., 169.

^aenu,¹ bead, xl.

^aenētepl Meluḫḫa, 144, 154.

^aēni-gugari (see šigugari), unk., 192.

^aēni imitti, 'right-eye stone', 169.

^aēni išsur(i), 'bird's-eye stone', 169.

^aēni nūni, 'fish-eye stone', 53, 184.

^aēni širgarri, Persian smaragdus (?),
154.

^aēni šaḫī, 'F' 9.

EN.NA (time previous?), 22.

^aennakki, unk., 170.

enšu, vinegar, xx, 136.

epēru, to cover, protect, 107.

epirru, cover, protection (?), 107.

epiru, dust, 17: — asurri, 'dust of the
wall', impure nitrate of potash and
carbonate of soda, 10, 1, 7, 11: —

ša šaḫī (of a pig-stye), ammonia, 10.

epiru ḫilšu (= LA), 'scraped dust', 25.

epištu (egirtu), 69.

erēku, to mould, xxix.

e-rib(?)-di-(e)-tū, 'A' 16.

¹ Add to the instances given on p. xl, Asb., Cyl. B, viii, 28, the tribute of
Abiyate the Arab, IGIūpl ^aPAR.AŠ.

erimmatu, 'case-tablet' (geodes), 107, xli.

erittu, mill, xliii.

erû (see *URUDU*), copper (pun on *erû* 'eagle', xii), bronze, 63, 66: — *abari* 'lead-copper', glaze, 197: — *Aggaditu*, 'Akkadian copper', glaze, 197: — *arĥu*, 'scaled copper', copper oxide, 69: — *BE*, 'roast copper', 137: — *BE ša ḫaḫkaru ikkalšu*, 'roast copper which the earth has eaten', *aes ustum* (?), or *tutty* (?), 63, 79: — *dannu*, 64: — *maziam*, 64: — *ša SUN.DU₁₃*, 'copper from a small pan', 74: — *watram*, 64: *erêsum pišû*, 'white bronze', 77.

erû, mill, xliiii: — *ḫāti*, handmill, xliiii: — *ḫabiši*, baker's mill, xliiii: *erû zibi*, xliiii: *erû ḫašilu* (?), xliiii: *erû paḫari*, potter's wheel, xliiii.

ESIR, ESIR.UD.DU.(A), bitumen, 41 ff.: *ESIR.UD.A*, pitch, 39.

ESIR.IGI.ENGUR, a kind of bitumen, 42.

ESI, diorite, dolerite, 163.

eškadru (?), bright yellow collyrium, 54.

ešmarû, enamel, 196, xlv.

ešû, to cover, xxvii.

gabû, alum, 33, xxxiv, 11, 35, 92, 177.
gabû = *ḫamun binû*, lichen of tamarisk, 34.

galala, marble, 160, 158.

(*GÂN.ZI*), *GÂN.ZI.ŠAR* ('plant robbing senses') = opium, xvii.

GÂN.ZI.GÜN.NU, *cannabis*, xvii ff.

garabu, leprosy, 89.

GAR.DU₁₃.DU₁₃, 'A' 7.

GAR.GI.NA, 'A' 5.

GAR.GI.ŠAG, 170.

GAR.KALAG.GA = *erû*, copper, 175.

GAR.KALAG.GA, *unk.*, 175.

GAR.RIN.RA(NA), bread-loaf, 23.

GAR.ŠAG.GA, agalmatolite, 182.

GAR.TAG.GA, 'A' 12.

gaššu, gypsum, plaster, 146, 148, xxxix, xlv.

GA.ŠUR.RA, basalt, 158, 162.

GE₄ = *ekêmu, parašum*, to strip off, of lamellar substances. 56.

GI.DUB tâmtim, unk., 175, 183.

GI.NA, hard (?), 82.

ginnu (of silver), 'standardized (?)', 62.

GI.RIN(RIM) arĥu, spurge, xxxviii.

GI.RIM.ŠAR.GUB.BA, fruit-shaped pyrites, 89 ff.

GIR.TAB, 'scorpion stone', 176.

GIŠ.LIŠ.DU₁₃, small needle, 120.

GIŠ.MÁ.GUR.GUR, cable, xviii.

GIŠ.MÁ.TU AN.BAR, 'bowl of iron', 87.

GIŠ.MIŠ, celtis australis, L., 168.

GIŠ.ŠAG.BAL, wooden head of spindle, 168.

GIŠ.ŠIR, a stone, 147: light, 147.

GIŠ.ŠIR.GAL, alabaster, 146, 144, 148.

gišširgallum, alabaster, 146.

GÜ, see xliiii.

GUG, cinnabar, 29, xxxvii.

GUG akapaša, 182.

GUG.SILA.ŠAR, rose-red stone, lepidolite, 178, xxxviii.

GUG(sându)-silim, 'love-stone', 188.

guḫlu, Kohl, 49, xli.

GUL(SUN), 85.

GÜN.NU ('twist, weave'), xviii.

gurgurru, 'rope plant', *cannabis*, xvii ff.

GURUN.GA.RAŠ.ŠAR, native arsenic, 54.

gusigu, Amazon stone (?), 178.

GUŠKIN, gold, 58, xxxii: — *ŠAR*.

DA, 'gold with alloy', 61: — *ḪUŠ*.

A, 'red gold', 59: — *ŠIG₇*, 'yellow gold', 59: — *SI.SA* 'rectifié', 61.

ḪA, 'fish-stone', a blue stone (?), 183.

ḪAB elili (see also *KIL* and *LAGAB* for *ḪAB*), 159.

ḪAB.ZA.NIM (see also *KIL* and *LAGAB* for *ḪAB*), 140.

ḫabalki(n)nu, steel (?), 81, to which add (?) 'W' 15.

ḫaiditum (falling?), 178.

ḫaia(t)tu (falling?), 178.

ḫalâšu, to scrape, to skim, 25.

ḫallu, vinegar, xx, 136.

ḫalpû, ice (?), 176.

ḫaltu, nutshell (?), 177.

ḫaltu, probably alum-stone, alunite, 176.

ḫandapillu = *PEŠ₄.PEŠ₄*, 105 ff.

hanna, fetidity (?), 102.
hannabāḫru, 'fuming fetidity', fuming sulphuric acid, xxxiii ff., 88, 93, 100, 102, 103.
hāpu, bank, 19 ff.: = *ḫadut šikani*, leaven, 20, 38.
ḪAR, essence (?), 114: mill, 161.
^a*ḪAR.AD.BAR*, mill of *AD.BAR*, xliii, 161.
ḫaragu, *ḫaragati*, a pan for fritting (?), xxvii, xxxi, 68.
ḫarāšu, to be or turn yellow, xxvii, xxxviii, 58.
^a*ḫarazias*, ^a*ḫarazium*, Hittite for cardamom (?), 79.
ḫarbabibillu (*ḫarbabilu*), chameleon, 102, 169.
^a*ḪAR.DUK.ĶA.BUR*, potter's wheel, xliii.
^a*ḪAR.GUD*, *cannabis*, xvii ff.
^a*ḪAR.ḪUM.BA.ŠIR*, red coral, 172.
^a*ḪAR.ḪUM.BA.ŠIR*, *withania somnifera*, L., 173.
^a*ḪAR.MU.UM*, *cannabis*, xvii ff.
^a*ḫarnanu*, *unk.*, 180.
ḫaršu, sharp, 194.
^a*ḫaršananu*, *unk.*, 180.
ḪAR.ŠU, handmill, xliii.
ḪAR zi-bu-um, xliii.
ḪAR.ZID.GŪ, mill for *GŪ*-flour, xliii.
ḪAR.ZID.ŠE, mill for corn flour, xliii.
ḫašabtu, *ḫašbāti*, dung-heap, 27 ff.: — *nāri* (= *A.GAR.GAR.AN.ĪD* (?)), bitumen, 41, 28, 43.
ḫašbu, potsherd, &c. (see *LA.*), 25.
ḫašālu, to crush, xxvii.
ḫašuru, apple, 93: — *abi*, 'apple of the thicker', 83.
ḫašilu (?), xliii.
ḫašaluna, murex, 19.
ḪĒ (= *ibkenmu*), vault (?), 74.
ḪĒ.AG, some form of zinc, cadmia, or brass?, 77.
ḫīl erī, 'gum of copper', chrysocolle, 70, 63.
^a*ḫina*, *unk.*, 178.
ḫu = *baḫ* (sign), 102.
^a*ḪU*, 'bird-stone', 155.
^a*ḪUL*, *unk.*, 182.
^a*ḪU.LAḪ.ḪA* ('like arsenic'), 54 (see following).

ḪU.LAḪ.ḪA = *lulutu*, 74 (see foregoing).
^a*ḫulalu*, ceruse, 135, xxxvii, 37: — *ini*, 'white lead for the eyes', 138, 144.
^a*ḪUL.GIG*, 'hate-stone', 188.
^a*ḪUL.LI.LI.GA*, colocynth, xvii, xlv.
ḫūlu, sand, 36.
ḫu[mubu], perished (?), 130.
ḫuppupu, to give way, 20.
ḫurašu, gold, 58, xxxviii, xlv: — *šaḏi*, 61: — *pišū*, xxxviii.
ḫurḫura[tu?], red colour (?), 51.
ḫuri, mines, 62.
ḫusaru, *unk.*, 180.
^a*ḫusigu*, amazon-stone (?), 178.
^a*ḪU.ŠIR*, 160.
^a*ḫu-si-ri*(?)—*ša*, *unk.*, 180.
ia, a syllable indicating a stone (?), xxxvii.
^a*iaeri*, ^a*iaerite*, ^a*ia'ertu*, white coral (?), 166, 165.
^a*iamibu*, green vitriol, 94, 88, 103: — *burrumu*, cobalt (?), 95, 88.
^a*ia-pa*, *unk.*, 165.
iarahḫu, husk (?), 97.
^a*iarahū*, red vitriol, 97, 88.
^a*iaartu*, white coral (?), 165.
^a*iašpū*, jasper, 170, xlv.
ibaru, fodder, xviii.
^a*ibari*, uncertain, 167.
ibkenmu, vault (?), 74.
^a*ibni mūti* (or ^a*IB.NI.BAD*), 172.
^a*ibD*, Hit, 43.
iddū, bitumen (moist), 14 ff.: = *iluNāru*, 43.
idgurtu, needle (perhaps pin), 120 (see *Babyloniaca*, xiv, 102).
^a*ID.ZA.SUH*, essence (?) of green vitriol, 99.
IGI, bead, see *ēnu*.
^a*IGI.3.GAL.LA* (cf. *šullulti ḫi* (?)) ... *me* (?), 'D' 17, 'A' 9.
^a*IGI.ḪA*, 'fish-eye', pearl (?), 184, 53.
^a*IGI.ḪU* (= *MUŠEN*).*NA*, 'bird's-eye stone', 169.
^a*IGI.LAG.GĀ*, a blue stone (?), 169, 183.
^(a)*IGI.MUŠ*, 'serpent's eye stone', 156, 187.
^a*IGI.MUŠ.GIR*, 'serpent's eye stone', 156.

IGI^aPAR.AŠ, 'bead of ^aPAR.AŠ',

143.

^aIGI.ŠAH, 'F' 9.

^aIGI.ZAG.GĀ, 'right eye stone',

169, 184.

ilit masuḫti, see elit mazukti.

ilit urši, see elit urši.

illuku, 'A' 10.

illuru, calix, 90: — *pāni*, bloom of the face, 46, 52.

IM, clay, 18: pus, 18.

imbu'u, 'H' 44, 'J' 77.

^aIM.DARA (*hāpu*), bank, 19.

^aIM.DARA (*šaršeru*), ferric oxide, 19.

IM.DARA.RA, 'O' 17.

^aIM.DIR (*šaršeru*), ferric oxide, 19.

IM-ga-li-[e?] (= *kalū*), yellow ochre, 32.

IM.GĪG, soot, black, 19 ff.

IM.GŪ, deposit, mud, leaven, 20 ff.

IM.GŪ.A.AB.BA, deposit of the sea, tidal mud, 20, 23.

IM.GŪ.BI.TIN.NA, yeast of beer, of *kurunnu*-beer, 20.

IM.GŪ.EN.NA, deposit of the river, mud, leaven of dough set aside, 20 ff.: bank, 38.

IM.GŪ.GAR.RIN.NA, leaven of bread, 20, 23.

IM.GŪ.ĪD.DA, deposit of the river, mud, 20, 23.

^aIM.GUG (*šaršeru*), ferric oxide, 19.

IM.GŪN.GŪN.NU, orpiment, 47.

IM.GŪN.NU, orpiment, 47: (red colour), 52.

(^a)IM.GUŠKIN (*šaršeru*), ferric oxide, 19: (*illur pāni*), yellow ochre, 32.

IM.IN.NU, clay mixed with straw, 18.

IM.IN.NU.RI, clay mixed with chopped straw, 18.

IM.KAL, soot, sublimate, *sal ammoniac*, 23 ff., xx.

IM.KAL(AG).GA, sublimate, 24.

IM.KAL.GUG, mercury, 29, xx, 24.

IM.KAL.KUKKU, uncertain (sugar of lead?), 30 ff.

IM.KAL.LA, 'sublimate of scrapings', *sal ammoniac*, 25 ff., 8: as grey paint, 19, 26: in *MT.*, 27 (replaces *IM.MAL.LI*), 19.

IM.MAL.LI, yellow ochre, 31 ff.: (replaces *IM.KAL.LA*), 19.

IM.MAL.LI.GUG, red ochre, 31 ff.

IM.MA.(AN.)NA, white sand for glass, 36, 142.

immanakku, white sand for glass, 36, 142, xlvii.

IM.NĪK.IB.ZUN, mortar, 18.

IM.NU.DUL, clay mixed with straw, 18.

IM.PAR.(RA), gypsum, 146, 19, 148: — of ^a*adbaru*, 150: — *Purattu*, 150.

IM.PAR.PAR.(RA), gypsum, 150.

IM.SAḤAR, as initial group, 141:

— *GĪG.KUR.RA*, black alum, 35, 33: — *PAR.KUR.RA*, white alum, 35, 33: — *TĀK.KUR.RA*, alum, 35 ff., 33.

IM.SIG₇, orpiment, 47.

IM.SIG₇.SIG₇, orpiment, 47, 19, 49 (?).

iṃṣu, vinegar, xx.

^a*iṃṣi*, 'E' 5.

IM.ŠIM, as initial group, 141.

(IM).ŠIM.BI.ZI.DA, a form of collyrium, 48.

IM.ŠIM.GUŠKIN, realgar, 47 ff.

IM.ŠIM.TĀK.SAḤAR, orpiment, 47 ff.: 'the friable stone', 51.

IM.TĀK, sublimate, 25.

IM.TĀK.AN.NA, sublimate, 25.

IM.URUDU, 'copper clay', 197.

inbu, distinct from Heb. 'ēnāb, 94: — *GA.RAŠ.ŠAR*, 55: — *karaši*, native arsenic, 54.

IN.NU.[UŠ], tragacanth, 32.

ipri erī, 'dust of copper', 73, xx.

isikku, soot, sublimate, esp. *sal ammoniac*, 23 ff., xx.

iskillatu, bunch of grapes, botryoidal (form), 105.

ismalu, enamel, 196.

issillatu, assimilated to something botryoidal, 105 ff.

istatirri, *istatirranu*, stater, xlvii, 63.

^a*iṣṣuri*, 'bird stone', *smaragdus medicus* (?), 155 ff.

iṣṣur hurri, bat, xviii.

išdu, base, xxvii: *išdi karaši*, 'root' of leek, 55.

išhilšu, properly *epiru hilšu*, 25.

iškilladu ša abni, vessel in the form of grape-cluster, 106 (Professor Beazley has kindly pointed out to me specimens of (late) Egyptian clay vases shaped like grape-clusters,

iškilladu ša abni (cont.).

Breccia, *Mon. de l'Égypte Gréco-Romaine*, ii, 2nd fasc., cviii: *Expedition von Sieglin*, Bd. ii, Teil 3, pl. xxxvi).

iškillatu, bunch of grapes, botryoidal (form), 105.

ʾišmī(k)ku, unk., 172, 139.

īṯru iṯrānu, salt efflorescence, *sal ammoniac*, 8, xxxix, 1, 14, 24: *īṯri ṭābtī*, *īṯru ša ṭābtī*, 'smoke of salt', 13 ff.

ʾittamīr, *itemīr*, 'it has appeared' (said by the midwife, of the new-born babe?), the stone in the geodes, 108.

ʾKA, iron ochre, red ochre, 81.

ʾKA.ĀŠ.GE₄.GE₄, red iron oxide + arsenic, cube ore, or mispickel, 84.

ʾKA.GĪG, black *KA*, 84, 81, 143.

ʾKA.GI.NA, haematite, 81.

ʾKA.GI.NA.DIB.BA, magnetic iron ore, 81, xlvī, 85.

ʾKA.GI.NA.KA.LAG.GA, a form of iron oxide, 81.

ʾKA.GI.NA.LAḤ, a form of iron oxide, 81.

ʾKA.GI.NA.ŠIG₅, a form of iron oxide, 81.

ʾKA.GI.NA.TIL.LA, *ferrum vivum*, 85, 81.

ʾkabašu, a red stone, 181.

ʾkaba- . . ., 110.

ʾKAK.A.BĀR, peg (?) of lead, sulphide of antimony, 52.

kakka[banu], starry, 130.

ʾkakkus, *ʾkakkusa*, *ʾkakkusa(k)ku*, probably pounded chalk, 180.

ʾKA.KUR, 'iron oxide of the mountain', 139.

ʾKALAG.GA, whetstone, 184.

ka(?)-lak(?)-ku-ta, 33.

kalgugu, *kalgukku*, *kalgukku*, red ochre, 31 ff., xx, 196.

KAL.KUKKU, see *IM.KAL.KUKKU*, 31.

kalū, yellow ochre, 31 ff., xx, 30: pus, 32: (replacing *IM.KAL.LA*, 19).

ʾkalū, *Zizyphus spina Christi*, L., xvii, 112.

ʾKA.LUM.MA, date-stone, 186.

ʾKA Marḥaši, iron oxide + *marḥaši*, 101: — *arḫa*, marcasite 100 ff., 88,

144 (yellow or green) mineral of iron oxide + *marḥaši*).

kamkama ša šadī, 47.

kammu, gall, tannin, 48.

kamunu, cummin, xlvī.

(ʾ)kamun (i)bīni (= *ʾagabī*, alum, 34), lichen of tamarisk, 34.

kanaktu, opopanax (?), xlvī.

ʾkanašū, opium, xvii.

kapālu, to twist, xxvii.

ʾKA.PAR, 'white' ochre, 81 ff.

kapāru, to smear, 20.

ʾkapašu, a red stone, 181 ff.: — *duši*, 182: — *uḫnī*, xlii.

kappa ippuṣ, 'he makes *kappa*', description of the roller, xviii.

karanu, wine-coloured, 130: grape, 94: *karanu bašlu*, boiled wine, *dibs*, 68.

ikaran ḥalla, wine-vinegar, 136.

karšu, cherry, xlvī.

ʾKA.SIG₇, yellow ochre, 81, 56, 84.

kasi ŠAR, rose, 179.

ʾKA.ŠĪR.KA.GI.NA, *kišir šadānu*, 82.

ʾKA šabiti, a punning way of writing *ʾKA.GI.NA.DIB.BA*, magnetic iron, 87.

[*ʾKA.ŠIR*].*NI.KŪ.E*, 'E' 7.

kašāru, to rub, 189.

ʾKA.ŠUR.RA, basalt, 162.

ʾkašurrū, basalt, 158, 162.

kaziru, juice (?), 112.

KI.A.AN.ĪD, black sulphur, 38 ff., xiii: — *A.GAR.GAR.AN.ĪD*,

bitumen, 38: — *A.RAD*, = *ru'ut* [*nāri*], 38: — *BA.BA.ZA.AN.ĪD*, gypsum, 38: — *ĤAL.ĤAL*,

black sulphur, 38: — *MULU.RU.GŪ*, black sulphur, 38: — *pišū u šalmu*, probably white and black

sulphur, 40: — *ŪḤ.AN.ĪD*, yellow sulphur, 40, 38.

KI.A.ĪD, bank of the river, 38.

ʾKI.ĀG, a plant (cf. the following), 188.

ʾKI.ĀG.GĀ, 'love-stone', 188.

kibaltu, cobalt (?), 95, xlvī, 88, 97.

kibir ilunāri, *kibri ilunāri*, black sulphur, 38, xiii.

kibritu, black sulphur, 38 ff., xiii: *kibrit ilunāri aruktu*, yellow sulphur, 40, 38: *kibrit ilunāri pištum*,

gypsum, 38: *kibrit ilunāri šalindu*, bitumen, 38.

KI. GIŠGAL, arch, dome, xxv.
 KIL, see also LAGAB and ĦAB.
^aKIL (or PA). ZA. ṬU, 135.
^aKIL.ŠE algamiš, powder (?) of corundum, 168.
 KIL.ŠE+BAR+ŠE, (KIL of barley), 168.
 KI. MUR, KI. MU. RA, ash, 104.
 KIN, hilt, 90.
^aKI. NAM. AN. NA (= ^aSAK. KI), 185.
 KI. NE (= iṣru, iṣrānu), 12.
 kinutu, 190.
 kirbanu, lump, 2 ff.
^aKISIM. ŠAR. A, unk., 181.
 kiṣir šadānu, 82.
 (ša) kišad aribi, colour of the raven's neck, 130.
 (ša) kišad asummatum, colour of the dove's neck, 130.
 KIŠIB, 'seal': — elili (of yellow (?) limestone), 159: ^a— GUG, 'K' 3: — IM. AN. NA, 'seal of IM. AN. NA', 37: ^aKIŠIB KA. GI. NA, seal of haematite, 82: ^aKIŠIB. ZA. SUḪ, seal of 'vitriol' (dyed), 93: ^aKIŠIB. ZA. ṬU, 'seal of white lead', 132 ff.
 kitinnu, tunic, xlv.
 kitu, flax, xlv.
 KUBABBAR, silver, 61 ff.: — ME. A, 62.
^aKÛ. BAL. E, corundum, emery, amethyst, 167, 52.
 kudimeru, cardamon, xlv.
 KÛ. ḪĒ, pompholyx, oxide of zinc, 71, 63; possibly brass, 71.
 kuḫlu (?), kohl, 50.
 kukubu, 175.
 KÛ. LAḪ. ḪA, 'washed' silver, 62, 70.
^aKU. MI, 193.
 KU. NĪK. IB (= ulāpu), 18.
 KU. NĪK. IB. ŠU. LAL, 'fox flesh', glue, 18.
 kummu, 183.
 kumukku (of šadānu), 82: ^akumuk ZA. SUḪ, seal of vitriol-(stained) stone, 82.
^akumu[ku], 'stone for cutting seals', 133.
 kunzi, bags (?), 134.
 KÛ. PAD. DA. NITA, male KÛ. PAD. DA, 15.

KÛ. PAD. DU (= šibirtu), 63: — siparri, 63.
 KÛ. PAD. DU. UŠ, 63.
 kupputu, to mass, 87.
 kupru, dry bitumen, 41 ff.
 kûri ša abni, furnace for metal, xxiv.
 kûri ša dakkanni, 'furnace of the arch', xxv.
 kûri ša šiknat ênâtebl-ša, 'furnace with a floor of eyes', xxv.
^akurkanû, curcuma, xlv ff.
^aKUR. RA, 'Kalkstein', 158.
^aku-saḫ-ḫi-li (?), unk., 182.
 kuššarru, 'parchment-writer', 189.
 kuššikku, sublimate (?), 24 ff.
 ḫabê-stone, amulet, 163.
 ḫablu, pubes, 21.
 ḫadu, ḫadu(t)tu, mud, yeast, 20: ḫadut nâri, deposit of the river, mud, 20: ḫadut šikani, leaven of dough set aside, 20, 22: ḫadut šikari, beer yeast, 20 ff.: ḫadut tâmti, deposit of the sea, tidal mud, 20.
 ḫaḫkad ^aalgamiš, head of corundum drill, 168.
^aḫaḫkadu, 'head-stone', 188.
^aka-nu-[u], see aban kanû.
 ḫaran enzi ša NIGIN, 'goat's horn with a twist', 68.
 ḫararu ša mē, eddy, xviii, 38.
 ḫarnu, ulap lubbutim, glue, 18.
 ḫupi (?) (stomach), 17.
 ḫukanu, of eye, 75.
 ḫurnu, orichalcum (?), 67, 63, 265.
 LA (= ḫašbu, epiru ḫilšu), potsherd, 'scraped dust' (scrapings) of the roads, 25: of pomegranate, rind, 27: of crab, shell, 27: of ostrich egg, shell, 27: of salt (?), 28: — BUGIN. BAD, of an old oven, 26: — GUL. GUL amelûti, of human skull, 28: — IM. ŠURIN. NA, of an oven, 26: — KUD. DA, scrapings of the roads, 25: — labira ša kibd[a?], 25: — ^aUD, ash of styx, xxviii, 28.
^ala-râme, 'hate-stone', 188.
 LAGAB, see also KIL, ĦAB.
^aLAGAB. GUG, 'K' 4.
^aLAGAB. KA. GI. NA (= šibir-[tum]), 82, 62.
 la'šu, massa, 63.

laḥianate (or *laḥi taknate*), 107, 110.

^u*LAL*, a red dye, 30, 161: — (?) *kula-lum*, 30.

^u*LAL*, safflower, 31.

lalaru, cricket, 106.

^a*LAL.SIG*, (?), *unk.*, 170.

^a*lamassu*, agalmatolite, 182.

^a*lamašti*, 'E' 3.

laptanû, colour of *laptu*-vegetable, 130.

[^a]*LA.RA.AḤ*, 'E' 4.

lardu, nard, xlv.

lasirbitu, laserpitiu, xlv.

lêru, arsenic, orpiment, 48, xxix, 46,

194: especially black paint (?) (antimony or natural arsenic), 51.

ligtu, gold (*patina*), 61.

lipi amelûti, 'human fat' = opium, xiii.

lipi nêši, 'lion fat' = opium, xiii.

LIŠ.A.BĀR, needles of antimony, stibnite, 116 ff., 50. (It is curious that *λάβασσον*, *stimmī*, contains the same consonants, possibly showing an inversion similar to *musukkanu*, *συκάμινος*).

lišanu, a wedge (of gold), 59.

lu'u, foul, 136.

lulmû, 'H' 42.

ⁱ*LU.LU*, xlv.

lulû, pompholyx, oxide of zinc, 71, xx, 63, 74, 195.

luludanitum, *lulidanitum*, capnitis, 75, 63, 143.

lulutu, pompholyx, oxide of zinc, possibly brass, 71, 74.

^u*lurpadu*, black alum, 34.

madakku, mortar, xliii: *kak madakki*, pestle, xliii.

magû (= gold), 61.

^a*MAḤ*, 'love-stone', 188.

Makanmû-copper, 65.

makdadu, 25.

malanu, tray or slide (?), xxvii.

(^a)*maltum*, 10, 104.

maninnu, 185.

marâku, to crush, xxvii.

ⁱ*MAR.GU.NU*, 103.

^a*marḥa(l)lu*, 100, 103, 139.

[^a*marḥaši*, marcasite?], see 100.

[*MAR(?)*].*HUŠ*, 103.

^a*MAR.HU.ŠU*, *marḥušu*, pyrites, marcasite, 100, xxxiii, 88, 103.

marû, *immari'u*, 69.

^a*MAŠDA* (*MAŠ.DĀ.E*), 'gazelle-stone', bezoar-stone (?), 187.

mašeldu, whetstone, 185.

^a*MAŠ.ID*, *unk.*, 183, 163.

maštakal, tragacanth, 42.

mašû, to be absorbed, 68.

mazuktu, mortar for crushing, xliii.

mekku, *unk.*, 196.

^a*meku*, *unk.*, 182.

Meluhḫû-copper, 65.

^a*menišuti*, *unk.*, 183, 144.

merku, applied to glass, moulded,

xxix ff., 132, 194.

mesat, washed, of saltpetre, 70, xx.

mesû, washed, 70: applied to silver, 62: copper, 70, 63.

^u*mesir UR.BAR.RA*, 172.

mil'u, saltpetre, 8, xxxiv, 1, 4.

millaku (?), copper ingot (?), 63.

^u*mîrgiranu*, pearl (?), 53.

^a*mîsis tâmtim*, *unk.*, 183, 175.

^a*mîsisu*, *unk.*, 183.

mîsu = gold, 61.

^a*MUD*, salt, 1.

MUD.A.BĀR, lead tube, 118.

MUD.ZABAR, bronze tube, 118.

^a*MUH.AŠ.GE₄.GE₄*, arsenious acid, 54, 56, xx: — *digili*, 57.

^a*multaspu* (?), *unk.*, 182.

[?].*MULU.DU₁₄*, 188.

^a*MUL.UG*, 'A' 10.

MUN, salt, 1: — *amanu*, 5: — *bûri* (?), lye, carbonate of soda (?), 14: —

e'(?)-ri, *unk.* (= *tâbat mânu*), 15: —

.*EME.ŠAL.LIM*, sodium chloride probably with magnesia, &c., 3 ff., 1: — *EME.ŠAL.LA*, 4:

—. *IN.TU.RA*, borax (?), 14, 1:

—. *KÛ.GA*, *sal gemma*, 3, 1:

—. *KÛ.PAD.DA*, bread borax (?),

15, 1: [—]. *MULU.GIŠGAL.LU*,

sodium chloride, probably with

magnesia, &c., 3.

^a*mu-nim* (?), 183.

murru, myrrh, xlv.

^a*mussirru*, *unk.*, 183.

musukkanu, mulberry, xlv.

mušiltu, blue vitriol, 98.

mušû, *muzû* (= misy), basic iron sulphate (so Taylor, *Journ. Hellen.*

Stud. for misy, 1930, 124: C.S. 17

makes misy (a) copper pyrites; (b)

oxidized pyrites), 113, xlv: male and

female, 114; — *šā lib zikari*, — *šā*

mušû, mušû (cont.).

lib[ŠAL], 114: *mušû* as gonorrhoea, 114.

aMUS, 'serpent-stone', 187.

aMUS.DIR, 'red serpent-stone', 187.

aMUS.GIR, serpentine or green feldspar, 154, 141, 143: male —, 154 (see *širgaru*).

aMUS.PAR, 'white serpent-stone', 187.

muštinnu, urethra, 35, 40.

mutan aPAR.AŠ.AŠ, uncertain, 145.

mutirru, rake, xxvii, 68.

muš(š)altu, sphere (?), 173.

aNA, unk., 167: mortar for crushing, xliii.

aNA.GÜ.BI.NA, mortar for crushing *GÜ*, xliii.

aNA.ZAG.ĦI.LI.ŠAR, mortar for *Lolium* (?), xliii ff.

aNA.ZA.GİN.NA, pestle for lapis, xliii, 131.

nadû, nâdu ša tiṭṭu, technical word for 'throwing' clay (?), 18.

naḥarmuṭu, destruction, 90.

naḥpatu, small needle (?), 120.

aNA.LU.A, uncertain, 184.

na-am of Sin, 176.

NAM.GEŠTIN.ĦU, a bird, 1, 6.

namirtu, applied to *šindu*, 46.

namru, namrûtu, lime, 146, 150 ff.: 'namrûtu of the sea', 151, xxxv.

namsidi (something to rub on?), 119.

NAM.TAR.(G)IRA, mandrake, xli.

aṇaḱu, Zizyphus spina Christi, L., the Arabic *neḱ*, xvii, 109 ff.

naḥâhu, to kindle, xxvi.

naḥaraḥtum, 48.

naḥâšu, to break in pieces, 73.

nappašu, chimney, breathing passage, 12.

naḥṭu, naphtha, 43.

aNA.PUR, limestone, 158.

nâr iluDumuzi, 'river of Tammuz' (Styx?), 93.

narâbu, ii, 1, 209.

narâtu, ii, 1, 209.

narkabu, upper mill-stone, xliii.

NA.RÛ.A, the technical word for 'throwing' clay (?), 18: cf. also 'H' 48-50.

narû, 'H' 50, 51.

aNA.ŠU.ZAG.ĦI.LI.ŠAR, pestle for *Lolium* (?), xlv, 103.

natku, xxviii, 151, 195.

naḥku, 109.

NE = me-il-, 8.

NE.A.ŠĀ.GA, 43.

NE.KÛ, charcoal, 77.

aṇibu, see *aṇibu*.

NI.KUR.RA, petroleum, 43.

NIM, (buzzing, hissing?), 140.

NIM.SIG₇.SIG₇, wasp (?), xxxviii.

nimeḍu, support, (stilt?), xxvii.

nipiš šir'ani, 73.

nipša erī, crusts of copper, *placitis*, 73, xx.

[*aNI*(?)].*ŠEŠLAM*, 'A' 27, 28.

nitiru, nitru, carbonate of soda, 11, xlv, 1, 7.

aNU.BU, 172.

aNU.KI.ĀG, a plant (see following), 188.

aNU.KI.ĀG.GA, 'hate-stone', 188.

NUMUN.GA.RAŠ.ŠAR, leek-seed, 55.

aNUNUZ, 'egg-stone', xl (for various kinds, xli, 'G' 16 ff.).

aNU.PEŠ₁, 'stone of not conceiving', 108.

aNU.Û.TU (abortifacient), 108 ff., 104.

aPA, white coral (?), 165.

aPAšá7 GÛN(šl)-šá(šu), white coral(?) with seven branches, 166.

aPA(or KIL).ZA.TU, 135.

pa'anu, bonne-bouche, 177.

pakâdu, 190.

PA.PA, papaver, xli.

paḥasi nâri, gypsum of the Euphrates, 43.

aPAR (= amna[ku?]), 142 ff.

aPAR.AŠ, moderately hard white stone, alabaster (?), feldspar (?), 142 ff.

aPAR.AŠ.AŠ, very hard white stone, chalcedony, 142 ff.

aḥpa-ra-ki(?) -tû, 'R' 8.

paṣiṣtu, a separated woman, 56.

paṣû, ?, 148.

paṣû, ?, xli.

aḥparuttum, aḥpaṣû, marble, 146, xli: sometimes alabaster, 148.

paṣzilu, iron, 80 (see *AN.BAR*).

pašallu, gold leaf (?), 59.

aPEŠ₁, geodes, 105, 25.

^aPEŠ₄. ANŠU, belemnite (?), 109.

^aPEŠ₄ nâri, geodes of the river, 108.

^aPEŠ₄.PEŠ₄, botryoidal haematite, 105.

^aPEŠ₄ tâmti, geodes of the sea, 108.

^apilakku (red, black, yellow) 'spindle-stone', belemnite (?), 186.

pilakku, axe, xlv.

pîlu, limestone, 158, xlv: — pišû, white limestone, 158, 146.

pîlûti, 85.

^apindû, 'fire-stone', pyrites, 88.

pišû, to turn white, xxvii, xxxviii.

piṭku, xxi, 63: — ḫuraši, 59.

^apuḫuttu, thistle, 87, 171.

^apulu, calcareous stone, limestone, 158.

^apulukku, unk., 187.

purad(ṭ)âti (= ^abišur atani), 109.

purd(ṭ)âtum, see above, 109.

purimānu, the colour of the wild ass, 130.

puṣu[su(?)]-, pounded, 131.

pu-u[š(?)]- . . ., 'A' 26, 27.

[^aR]AB.KĀM.ME, 'E' 3.

raḫâšû, 104.

raḫâtu, to bubble, xxvii.

raḫte, fine (?), 83.

râme (aban râme), 'love-stone', 188.

rašâšû, to turn red, xxvii, xxxviii.

RAT. A. BĀR, gutter (?) of lead, 118.

raṭâbu, to be moist, xxxvii.

amRIK, amriḫḫu, apothecary (?), 177.

risittum, tanning (?), 34.

^arubuṣ ilu^alpi, 'dung of divine bull', 189.

^arubuṣ ilu^aŠE.SAG, 'dung of ŠE.-SAG', 189.

ru'ut ilunâri, yellow sulphur, 38.

ru'ut tâmti, 'spittle of the sea', 41.

ruššû, red colour, xxxviii: of gold, 59: of copper, 64.

^asâbu, 107.

^aSAG.DU, 'head-stone', 188.

^aSAG.GE₄.A.BA, unk., 185.

^asaggil(i)mut, 'thunderbolt', nodule of iron sulphide, 111, xxvi, 75, 102 ff.

sagiru, of gold, 61.

^aSAG.KAL, unk., 185, 139.

^aSAG.UD+ŠAL+KAB, head of drill of corundum, 168.

SAḪAR, dust, 17: — .GUŠKIN, realgar (?), 47: — .SIS, sal ammoniac, 12.

^asaḫḫû, unk., 185.

^asaḫmu, alum, 34.

saḫêru = gold, 61.

^aSAK.KI, unk., 185.

samânu, a head disease, itch, ring-worm, 11, 18, 28: — ša GIŠ.ZI (= tultu sântu), 11: — ša igari, sal murale, 11, 1, 7.

samîtu, the base of a wall, 18.

^asamṭu, acacia, xviii.

sâmu = gold, 61: red, xxxviii.

sanapu, sinapis, xlv.

^asându, various red stones, 154, xxxvii, xlv: sându, litharge, xxix, 194:

^asându Marḫašī(tu), sandrisitae, aventurine, 100 ff., xlv, 88, 195:

^asându ḫalitū, 194.

sâsu, red lead, 135 ff.

sâsu (= TAS.ME.A), moth, 12.

^aSIG₇.SIG₇, 'very yellow stone', 47, 54. SIG.ZA.GÎN.DIR, red purple (cloth), 130.

SIG.ZA.GÎN.GÍG, dark blue (cloth), 130.

siḫru, essence (?) of green vitriol, 91, 99.

^asikkat A.BĀR, peg (?) of lead, sulphide of antimony, 52.

siḫêru, to roast, 137.

^aSILA.ŠAR, 'rose-stone', lepidolite, 178.

Sin-ḫadrû, bright yellow (collyrium), 54 ff.

Sin-lurmâ, eye-disease, 54.

siparru, copper, bronze, 63: — arḫu, scaled copper, copper oxide, 63, 67, 195: — šibirti, 'Morceau non façonné', 63.

sirṣu, a glass, xxviii ff., 16, 151, 195: — natku, smelting (?) glass, xxviii, 151, 195.

^asû, whetstone, 184, 162.

su-du-ru (cf. su-ud- . . .), 'A' 12.

SU.DU₈.ŠI.A, sandiver, 176.

su'lu, ladle (?), xxvii.

SÛ.ḪĒ, spodos (?), 63, 71, 77.

^aSUḪ.ŠAR, 'A' 11.

^aSU.MUŠ.(KU), unk., 186.

SU taḫ(?)-šī-a(e), skins for rafts, 176.

SÛ.UD.ĀG.(GĀ), brass, 71, 76.

su-um- . . ., 95.

(^ašabitu) (^aMAŠDA), 'gazelle-stone', bezoar-stone (?), 187.

šādu, to melt, xxvii.
šadidu, eye-paint, 49.
šaidu (= gold), 61.
šalmu, black, xxxviii.
šalamtu, *šalamdu*, basalt, lava, pumice, 158 ff.
šapāru, to scratch, 133.
šarbatu, storbus, *styrax, xxvi, xxviii, xlv.
šariru, red gold, 59, xxxviii.
šarpu, silver, 62.
šI, 'gall-stone', 183, 53.
š[i(?) - i]n(?) - du(?), 'V' 17.
šipātu, 'W' 15.
šiprētu (small egg-shaped beads), xli.
šipru, moderately hard, and very hard blue stone, sapphire, 129, 133 ff., xxi, xxvii, xxxi, 143, 168, 195: — *šuraši*, lapis spangled with gold, 133.
šip-pa- . . ., 62.
šiptu, *unk.*, 187: — *Gutitu*, 188.
širga(r)ru, serpentine or green feldspar, 154, 135.
šit hurri (of copper), 63.
šumbiru, a lunate ornament, 171.
šurrušu ša abn[i], dyeing of a stone, xlv.

šadādu, to draw (of fires), xxvii.
šadānu, haematite, 81: — *baštu*, *ferrum vivum*, 81: — *damku*, 81: — *dannu*, 81: — *namru*, 81: — *šabitu*, magnetic iron, 81, 85.
šaddu, scraped (?), xxix, 194.
šaddā, xxxi, 101, 195.
šaddaru, *hyoscyamus niger*, L., 78.
šadū, quartz (?), xxxi, 194: (note, however, the difference of *šad* in Sect. J, and *šadā* in Sects. K and L).
šadū, pillow (?), 84, 179.
šA.GA.RA.unk., 192.
ŠAH.BAR.GÜN.NU, porcupine, 170.
šAKAN UD + ŠAL + KAB, *šik-katum algamiš*, 168.
ša kappi iššuri, *Smaragdus Medicus* (?), 157.
šakar, hilt, 90.
šakiru, a kind of *hyoscyamus*, 78.
šAL.LA, 'womb-stone', *unk.*, 182, 144, 109.
šAL.LA (= gold), 61.
šAM, hard red sandstone (?), 192.

šamaštu, blue vitriol, 98, xxxviii, 88.
šaman iddi, petroleum, 43.
šamaššammu, sesame, xlv.
šamaštu, to make an extract (?), 74.
šamē, 'heaven-stones', 99.
šamgu, see *šusigu*.
šami nissati, drug for sorrow = *cannabis*, xvii ff.
šammu, hard red sandstone (?), 146, 192.
šammu šA.LAL, (a dye), 30.
šammu ša aladi, 'birth-drug', 105.
šammu ša U + U, 179.
šāmu (?) (*tašimammi*), 68.
šam-ri (?) - *ša*, see *šus-ri* (?) - *ša*.
šapāku, to make a (dome-like) heap, 74.
šaplita kūri, 'under-part of the furnace', xxv.
šargubbū, *šAR.GUB.BA*, iron pyrites, 89, 88.
šarše(r)ru, ferric oxide, 19, 196.
šasuru, wasp (?), xxxviii.
šA.ŠA.KALAG.GA, 'H' 20.
šA.ŠAR, *hyoscyamus niger*, L., 78.
šā šelaša ŠAR, onion, 180.
šāšu (= gold), 61.
šā U + U + U ŠAR, onion, 179.
šA.U.U, talc (?), 178.
še-im hu-[un-mu-bu], colour of blighted (?) corn, 130, 132.
ŠE.MUR, ash, 104.
ŠE.SAG, 'corn top', 97.
šer šelabi, 'fox flesh', glue, 18.
šE.TIR, see *šI.TIR*.
ŠE.TU hiliti, gummy varnish, 114.
ŠE.ZA.GİN.DUR, colour of blighted (?) corn, 130, 132.
šI(ēnu) šā ri (?) - . . ., 53.
šibirtu, applied to copper, 63: silver, 62: *šadānu*, 82.
šiblukku, bubble, xxvii.
šigtu tuskū, 'washing of tuskū', 73.
šigugarum, *unk.*, 192.
šihiltu, effluence (?), 73.
šihlē, *lolium temulentum* (?), xliii.
šI.HUŠ, 89.
šI.KA = LA = hašbu, *epiru hašbu*, 25.
šikanu, *šikinnu*, in the phrase 'dough left over as leaven', 20 ff.
šikinnu, see *šikanu*: = *PEŠA.PEŠA*, 105.
šikkatu, alum, 176: cf. 'H' 44, 'J' 77.
šiknu ša nāri, mud, 20 ff.

šilikku (?), baking (?), xlv.

ŠIM. BI. GUŠKIN, realgar, 46 ff.

ŠIM. BI. SIG₇. SIG₇, orpiment, 47 ff.

ŠIM. BI. ZI, a form of collyrium, 50.

ŠIM. BI. ZI. DA(M), general word for kohl, stibnite, 50 ff.

ŠIM. BI. ZI. DA. SIG₇. SIG₇, orpiment, 47.

šimbizidū, a form of collyrium, 49.

ŠIM. BI. ZI. IGI. GÜN = *egū ša ekī*, 50.

ŠIM. DIR, ferric oxide, 19.

ŠIM. GUG, ferric oxide, 19.

ŠIM. GUŠKIN, realgar, 48, 46.

ŠIM. MAR. GU. ŠU (*AH.* 146), 103.

ŠIM. SAḤAR, orpiment, 47 ff.

ŠIM. SAḤAR. GUŠKIN, realgar, 47.

ŠIM. ŠE. TU. GUŠKIN, realgar, gold paint, 46.

ŠIM. TĀK. SAḤAR, orpiment, 47 ff.

ŠIM. ZI. DA, some form of collyrium, 50.

(*šindu arku* (?)), sandaraca, 46.

šindu ḥurašu, realgar, 46 ff.

šindi sal[mī] (?), black (?) paint (native arsenic or antimony?), 48.

šimmu, ivory, 163.

šīpu, arsenic, realgar, gold paint, 46 ff., xxix, 194.

širdū, sard (?), 19, 176.

ŠIR. GAL, alabaster, 146 ff.

širnūma, *unk.*, 192.

širšu (*bušu*), bat, xviii.

šīir šu[mī], 'H' 48.

ŠI. TIR, *ASE. TIR*, garnet (?), matrix containing it (?), 163 ff., 89, 139, 158 ff.

(*AN?*.) *ŠI. TIR*, 88.

šī(?) - i . . . , 95.

šū, pumice, 189: male and female, 190.

ŠU alallum, 159.

(*a*) *ŠUBA*, the base of the names for the vitriols (alumen), 93.

(*a*) *šubū*, the base of the names for the vitriols (alumen), 91 ff., xxxvii: — *arku* (= *ianibu*), green vitriol, 94, 88: — *Uruki*, vitriol of Erech, 94, 88.

aŠU. ERI, stone in the geodes, 108.

šuhtu, verdigris, 71, 63: — *ḥuraši*, tarnish (?) of gold, 71.

šullulti kī (?) . . . *me* (?), 'A' 17.

šumu zakru, 'H' 49.

šupšukti, 'E' 4, 7.

šurdu ša ilu Šamši, sunstroke, 39.

šurmenu, terebinth, xlv.

šuršummu, yeast, 20 ff.: — *ša kurunni*, yeast of *kurunnu*-beer, 20 ff.

ŠU. SI. A. BĀR, 'finger of lead', 119.

T and Z interchanging, 134.

aTAG. GAZ (*a*tag-gaz, *a*takkasu), xli ff., probably cut stone: —

aPAR. AŠ, 144: — (*a*)*si-e*, 184: — *a*ukmī, 182.

taḥ(?) - ši-a (-leather) slippers, 176.

taiaru, round, 194.

aTAK marḥuša tūbitum, 104.

TĀK. SAḤAR, 48.

tamrata, (spoons (?)), xxvii.

tamšiltu, mould, xxvii.

tarabanu, trona (?), xxix, 194.

tarmanu, sling stone, 103, 111.

aTAR. MUŠ, lupins, xlv.

TAS. ME. A, moth, 12.

tasme ša igari, 12.

TAS. ME. ME = *samānu*, 12.

tašlamtu igari, 12.

tašnē, duplicate (?), xxvii.

tatturrū, 2.

*a*te- . . . , 'E' 9.

tersitu, blue copper frit, 68, xxix ff., 194: red copper frit, 69, 194: — *damku*, 194.

tiknu, 'A' 11.

*a*tik *šamē*, *unk.*, 192.

tikpu (spots), 179.

*a*tī(*m*)*bu*(*t*)*tī ekli arkitu*, an animal, 172.

TIN. TIR. ŠAR. GIŠ. ŠINIG, lichen of tamarisk, alum, 34.

aTU, red vitriol, 97, 88.

tukpīt[um] of *šadānu*, 82.

tūltu sāmto (= *samānu ša igari*), 11.

aTUR. MI. NA, coloured marble (?), or some calcareous stone (?), 193.

aTUR. MI. NA. BANDA, breccia, 193.

tušē, for *dušū*, 175.

tuskū, *tuškū*, spodos, oxide of zinc, 71, xx, xxxi ff., 63, 195.

ṭābatu, vinegar, 136, xx.

ṭābtu, salt, 1, xxxiv: — *amāni*, red *sal gemma*, 5, 1: — *A. ŠAL. LIM*, a form of saltpetre (?), 10, 1: — *bavi-*

tābtu (cont.).

katu, borax (?), 14, 1: — *būri* (?),
lye, carbonate of soda (?), 14, 1:
— *EME.ŠAL.LIM*, sodium chlo-
ride, probably with magnesia, &c.,
3, 1: — *iṣrāni*, efflorescent salt, 13:
— *libbi nāri*, sodium chloride, prob-
ably with magnesia, 3: — *mānu*
(= — *e-*(?)*-ri*), *unk.*, 15, 1: — *šadī*,
sal gemma, 5, 13: *ṯābtī šikkatī*,
alum, 176.

ṯalilu, dew, calcareous spar in geodes
(?), 106.

ṯaptu, melting pot, xxvii.

ṯēnu, clay, 18.

ṯi(t)ṯu, mud, deposit, leaven, 20 ff., 18.

ṯu, with definite relation to weight,
137.

tubitum, 104.

ṯuban (?) *šasurri*, stone in the geodes,
108.

ṯUD, *styra, xxviii.

UD.DA.DI.DI (leaven), kept back
for a day, 22.

UD.DA dikat, (cf. *above*), 22.

UD.ḤUB.ŠU.ELTEG.A, 'O' 18.

ṯUD+ŠAL+KAB, corundum, eme-
ry, amethyst, 167, xxi.

ṯU.DINGIR.GUD, 'dung of the
divine bull', 189.

ṯU.GIR, acacia, xviii.

ṯU.A.AB.BA, 'spittle of the sea',
41.

ṯU.AN.İD.MULU.RU.GU, yel-
low sulphur, 38 ff.

ṯuhulu, alkali, 15, xxx, 1, 7, 11, 158:
— *ḥarṣu la taṯaru*, sharp, not round,
15: — *ḥarnanu*, of salicornia, 14 ff.

ṯuhulu, basalt, lava, pumice, 160, 158.

ṯukittu (?), *unk.*, 163, 167.

ukuru, ochre (?), 265.

ṯuknū (see *ṯZA.GIN*), lapis, tur-
quoise, ultramarine, azurite, blue
glass or glaze, 129, 132, xxi, xxviii,
xxxvii ff., xlvii, 194: female, 132:
— *ellu*, 129: — *ḥAR*, ground up,
131: — *ibbu*, 129: — *merku*,
moulded (blue glass), xxix, 132,
194: — *namri*, 129: — *sānu*, red,
or red-purple (glass), 194 ff.: —
šadī, 139, 144.

ulapu, mortar, 18: — *lubbittim*, *ḥarnu*,
glue, 18.

ṯul(?)*-la-nu-um*, *unk.*, 169.

ṯUL UD+ŠAL+KAB (*diḫari alga-
miši*), 168.

umminātē (-boxes), 33.

Ṭ.MU.UN (= *amanu*), red salt of
Media, 5.

uppu, drum, tube, 118: — *abari*, lead
tube, 118.

ṯUR, *unk.*, 170.

uraku, *unk.*, xxvii, 'S' 36.

ur-b[a]- . . ., 'A' 19.

ṬUR(?)*GA.RAŠ.ŠAR* (*išdi karaši*),
'root' of leek, 55.

uriahlu, red vitriol, 97, 88.

urnu, yellow (green) snake, 170.

urriḡa, 170.

urriku, 170.

urṣu (-mill), 2.

URUDU, copper, bronze (see *erū*), 63,

197: — *A.EN.DA*, 63: — *BE*,

roast copper, 79: — *GAR.GID*.

DA, 'S' 36: (G)*IRA*, male, 64:

— *ḤU.LAḤ.ḤA*, washed, 70, 63:

— *LAḤ.ḤA*, refined, 70, 77: —

NIG.KA.LAG.GA, bell, 64:

— *SAḤAR.ḤU.LAḤ.ḤA*, cop-
per out of the mine, 63, 70:

— *SAḤAR.LAL*, ingot(?) of cop-
per, 63: — *SAḤAR.KI*, — *SA*

ḤAR.ŠU (= *la'šū*), *massa* (?), 63:

— *ZA.Rİ.IN*, orichalcum (?), 67,

265: — *TIL.LA*, living copper, 64,

88: — *UR*, 10: — *ZABAR*, 65:

(*URUDU.NI.TUK.KI, URUDU*

MÁ.GAN.NA, URUDU.ME

LUḤ.ḤA, 'S' 32-5).

ṯurutum (?), *unk.*, 167.

uṣmeta (*uṣṣipta*), 43.

urṣu, mortar for crushing, xliii.

uṣṣā, diorite, dolerite, 163, 158.

ṯU.TU, stone contained in the geodes,
108.

ṯUZ, *unk.*, 167.

uzkaru, crescent, 175.

ZA.AN.NE, 8.

zabalam (= zaffre, safflor (?)), 97.

ZABAR, copper, bronze, see *ṣiparru*:

verdigris, 70, 63: — *ruṣṣā*, red cop-
per, 64.

ṯZA.GIN, (see *ṯuknū*), lapis, tur-
quoise, ultramarine, azurite, blue

glaze, 129, 132, xxxvii, 143: —

.ANŠU.EDIN.NA, of the colour

^aZA.GÌN (cont.).

of the wild ass, 130: —.AŠ, moderately hard blue stone, —.AŠ.AŠ, very hard blue stone, sapphire, 133 ff., xxi, 129, 143: —.BUR.UM.UT.TUM (burumitum), variegated, 130: —.DIR, red-purple glaze, 132, 194: —.DUR₅, (simple glaze), 129, 132, 194: —.GAL, 132: —.GEŠTIN, karanum, wine-coloured, 130: —.GIŠ.AŠ (= ŠU-u, šipri and šabrum), 133: —.GŪ, neck-lapis, 133 ff.: —.GŪ.TU (zagingutū), grey on the dove's neck, 129: —.KUR.(RA), 132: —.LU.ŪB (laptanū), colour of the laptu-vegetable, 130: —.MUL.MUL (kakka[banu]), starry, 130: —.NA.ZAG.LAL (= pussu[su]), pounded (?), 131: —.SIG₅.(GA) (= šipru), 133: —.šabrum, 133: —.UGA.ĦU, dark sheen on raven's neck, 130: —.ZUN (= šipru), 133: —.ZUN.GUŠKIN (= šipir ħuraši), 'golden sapphire', 133.

zaginurū, (clear glaze), xxviii, 129, 194. zahālū, gold leaf (?), overlay (?), 60.

^azakānu, unk., 176.

zakte, sharp (?), 83.

„ (= ia₄) -za-ku-ur-a-a-ku, 129.

^aZALAG, lime, 146, 150 ff., 197 (ZALAG-ram).

^azalaku, unk., 176.

zalhu (= gold, in Shubarti), 61.

^aZA.MIR.IGI, ceruse for the eyes, 135.

^azanibu, 94.

^aZA.NIM, ceruse, 140, 135: —.IGI, for the eyes, 135: ZA.NIM.IT.TAR, 136.

zarinu, orichalcum, 67, 265.

zarubam, of silver, 62.

^aZA.SU, ceruse, 140, 135.

^aZA.SUH, the base of the names for the vitriols, 91, xxxvii, 88: male and female, 94: —.DIR, red vitriol, 97, xxxiii, 88: —.DU₁₃, uncertain, 99: —.GAL, uncertain, 99: —.ID.KAB.BA, uncertain, 99: —.ID.ZID.DA, uncertain, 99: —.kibalti, cobalt (?), 95, 88: —.SIG₇, green vitriol, 94, 88: —.UNU.KI, green vitriol, 94, 88: —.UNU.KI.GAL, cobalt (?), 95, 88.

^aZA.TU.(ni-ir) white lead, 135 ff., xx, xxxvii: marks effervescence in stones, 135 ff.: —.alalum, a yellowish (?) limestone, 135, 158: —.BE, sāsu, red lead, 135 ff.: —.elallu(mi) (alallum), a yellowish (?) limestone, 135, 159: —.ID.ZA.SUH, a vitriol, 135, 99: —.IGI, ceruse for eyes, 135: —.IGI.MUŠ.GIR, Persian smaragdus (?), 156, 135, 144: —.KUR, 139: —.mada(l)lum, 135, 157: —.MUŠ.GIR, malachite, green calcite, green marble, 135 ff.: —.PA.HU.NA, Smaragdus Medicus (?), 135, 155 ff.: —.PAR.AŠ (parātu(?)), calcite, 135 ff.: —.PAR.AŠ.AŠ, aragonite, magnesite, white marble, 135 ff.: —.TAB, 135: —.ulalum, a yellowish (?) limestone, 159.

zē pahari, potter's dross, 25.

^azibit, unk., 187.

^aZIB.TUM.E, 188.

zibum, xliii.

^aZID.A.BAR, 'powder of lead', 52 ff.

ZID.AN.BAR, iron filings, 81.

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^azukaḳipū, 'scorpion-stone', 176.

^aZUR.ŠAR.GUB.BA(BU), decomposition of iron pyrites, green vitriol, 94, xxxiii ff., 88 ff., 102 ff.

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ERRATA ET CORRIGENDA

- P. 2, l. 9. For 'asû' read 'asû'
- P. 15, l. 19. For '“X” 14' read '“X” 15'
- P. 19, l. 4. For 'ŠIM...' read 'ŠIM.GUŠKIN'
- l. 32. For 'sar'dûn' read 'sâr'dhâûn'
- P. 25, last line but 3. For 'hallaş' read 'halles'
- P. 29. Add to the drugs, &c., from the furnace
haḥû ša utuni, KAR. 186, 6 and 192, iii, 13, 15, 51 (cf. CT. xix, 1, K. 55, 22, ... BIL = ha-ḥu-û). Maḥlû iii, 116 must be read *alikhakimma haḥû ša utuni umminu ša diḡari*.
- P. 49, l. 6. For 'şadiddâ' read 'ş'diddâ'
- P. 56, l. 10 from end. For 'aMUḤ.AŞ.GE₄.GE₄' read, as the actual form, 'aMUḤ.AŞ.GĪ.GP'
- P. 67. *Zarinu* occurs VR. 63, i, 43 ff. (Nbn.) in a description of the sun-god's crown *agu ḥuraşu simat ilutişu ša apru raşuşu tiḡnu tuggumu burnû zarinu šattişamma šunşudu la ibaşû tenâşu manama šarru alik maḡri-ia tenê agî šuûti la* . . . 'the gold crown, the decoration of his divinity, which encircles his head; there had been no (re-)decoration (or) polishing of (its) ornament, no annual rubbing of its *zarinu*; (as for) its renovation (?) (change (?)) no king going before me had [turned his mind] to the renovation (?) of this crown'; ii, l. 3, *ša epiş agî ša la zarinu* 'in order to make the crown without *zarinu*'; and l. 36, *agâ ḥuraşu kima labirimma ša* (sic, read *ša-la*) *zarinu in aGIŞ.ŞIR.GAL u aMUḤ.AŞ.GĪ.GĪ šuşubu in abnê^{pl} nisiḡtu šukulu*, &c., 'the gold crown as of old (but) without *zarinu*, wrought with alabaster and arsenious acid, completed with precious stones, &c.'. That is, the *zarinu* of which the crown was previously made, was so tarnished that Nbn. remade it of alabaster painted with king's yellow or orpiment (p. 56). In Thureau-Dangin, *Rit.* 75, 8 five of the gold vessels (*şappi*) in a ritual may be of *ḥuraşu ša zarinu abni* . . .

A tablet (period of Gimil-Sin, quoted by Scheil, *RA.* 1915, 168, unpublished) mentions '1 $\frac{2}{3}$ ma-na ŠĀ.BU.A *zabar za-ri-in* 20 ĤI.LAL *zabar za-ri-in ki-lal-bi* 17 $\frac{1}{3}$ ma-na 8 gin, &c.', which shows its connexion with bronze at this date.

Its synonym *ḡurnu* suggests the Syr. *k'rân*, a form of tin mixed with lead, or perhaps *k'rîn*, *aes ustum*.

Zarinu must therefore be an important metal connected with copper ('S' 25, 26) and bronze; used to represent gold (Scheil, '*Cuivre ou bronze frappé et recouvert d'or*', *RA.* 1920, 208); replacing gold in temple plate; and having a synonym at all events suggesting an alloy. A Syriac word *zarina* for a yellow earth of Armenia, near Cappadocia (*HS.* ii, 303) (although connected, probably erroneously, by the Syriac writer with *zarnîkâ* 'arsenic'), suggests at once orichalcum, held by some to be a form of brass, made with calamine (carbonate of zinc) an earth found in the country of the Mossynoeci on the Black Sea (Pseudo-Aristotle, *De Mirab. Aus.*, lxxii, 63).

ZA.RĪ.IN is also used in connexion with (a) wool; (b) unburnt brick. Scheil has collected some of the passages; (a) for wool, *RA.* 1920, 208, an unpublished vocabulary from Susa mentioning '*sig gud*, *sig ḥuṣ-a*, *sig za-re-in*, *sig igi KA-gâ*, *sig pîr-pîr*, *sig gig*', where *sig ḥuṣ-a*, 'russet wool' would allow

us to see a colour for *sa-re-in* ('golden fleece'); and a tablet of Bur-Sin's period, *TUG ša sa-rin*; (b) for brick, where *ZA.RĪ.IN* and *ù-ku-ru-um* are used in contrast, e.g. a tablet of Bur-Sin's period (Scheil, *RA.* 1915, 163), where there are several entries for bricks which are not defined either by *ZA.RĪ.IN* or *ù-ku-ru-um* until Rev. i, 5 and ii, 12, 14, where the totals are given described as *SEG ù-ku-ru-um*, while in Rev. ii, 15 follows a separate entry 2 *ŠAR SEG.ZA.RĪ.IN...ŠĀ GA.EŠ.KI*, a special kind from (or for) *GA.EŠ^{ki}*.

In a tablet *c.* 2400 B.C. (Legrain, *RA.* 1935, 128) the contrast between bricks defined by *ZA.RĪ.IN* and *ù-ku-ru-um* is obvious.

Here again we must see the colour 'golden-yellow' for *ZA.RĪ.IN*, and *ukuru* must be cognate with the Syr. *ûkrâ*, defined in *PST* as *pulvis aurifabrorum et quicquid luteum est*. If *ûkrâ* is *ὤκρα* ('ochre', a word not occurring in Greek until the fourth century B.C., although, of course, the verb *ὤχρω* is much earlier) we might perhaps see in it a borrowing from Mesopotamia (especially if *πλῖνθος* is *libittu*, unburnt brick). The kinds of Mesopotamian unburnt brick (which is in general yellow) might well be differentiated by the two colours gold-yellow and yellow ochre. I cannot agree with Sidney Smith, *Bab. Hist. Texts*, 59, or Langdon, *NK.* 264.

- P. 71 (and 79, 118, 148, 151). For '1600 B.C.' read 'seventeenth century B.C.'
- P. 87, l. 2. For '*MĀ*' read '*MĀ*'
- P. 93, l. 23. For '*hâzzûrâ*' read '*hazzûrâ*'
- P. 98, l. 12. For ' "H" 15: "J" 78, as *šim-ma-ia-tû*' read ' "H" 15 (?): "J" 78, as *mu-šal-[tû]* = *šim-ma-ia-tû*'
- P. 126, l. 21. Add 'to' before 'see'
- P. 129, end. An additional text for kinds of *uḫnû* will be found in Van der Meer, *MMAP.* xxvii (1935), 20.
- P. 149, l. 6. For 'Oliver' read 'Olivier'
- P. 177, l. 16. For 'poured on' read 'poured into'



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